

ALEXANDER VON HUMBOLDT

ALEXANDER VON HUMBOLDT:

A Biographical Monument.

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Translated from the German,

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LIFE

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CHAPTER I.

ANCESTRY—BIRTH—YOUTH—FIRST EDUCATION—UNIVERSITY.

THE ancient noble family of Von Humboldt had its origin in Pomerania, where it formerly possessed estates, situated in the principality of Camin, and in the district of New Stettin. But at the time when Prussia obtained possession of these parts, descendants of this old family served the margraves of Brandenburg on diplomatic and military expeditions; and the family removed from Pomerania to near Magdeburg, where it became possessed of additional estates.

During the life of Frederic William the First, a captain Hans Paul von Humboldt served in his army, and married the daughter of the Prussian major and general adjutant, Von Schweder. He had three sons by her, one of whom, Alexander George, is of particular interest, as he was the father of the celebrated Alexander.

The baron Alexander George von Humboldt, born in 1720, served for a long time in a dragoon regiment, was then made major, and, during the seven years' war, adjutant to duke Frederic of Brunswick, who frequently sent him with verbal embassies to Frederic the Great. Major von Humboldt was inheritor of Hadersleben and Ringesleben, and subsequently took

the castle of Tegel, between Berlin and Spandau, three leagues north-west of Berlin, in fee farm of the royal Woods and Forests. Tegel had originally been a hunting seat of the great Elector, and a royal hunting establishment was kept there under Frederic the Great. This castle has latterly become important to the family, and the major made it a place of retirement for his age after his restless life, but was unfortunately called away by an untimely death. When the seven years' war was over, Frederic the Great made Major von Humboldt one of his chamberlains, in 1765, and at the same time he was attendant chamberlain on Elizabeth, the newly-married princess of Prussia, and had on that account to live in Potsdam. But when this unhappy marriage of the prince of Prussia was dissolved, and the princess had been taken to Stettin, the Major von Humboldt, his service being over, exchanged Potsdam for Berlin, and lived partly in the capital, and partly in his neighbouring castle of Tegel. He had, however, by no means lost the favour of the prince, (subsequently Frederic William II.,) for he visited him once annually in Tegel; and it may with certainty be surmised, that had the major survived the prince's accession to the throne, he would have advanced him to an important position in the state, or perhaps even have entrusted the formation of a ministry to him.

Major von Humboldt was married to the widow of a Baron von Holwede, whose maiden name was Von Colomb, cousin of the princess Blücher, and niece of the venerable president Von Colomb in Aurich. She had a son by her first marriage, who served as officer in the regiment of Gens d'armes. The family of Colomb comes from Burgundy, where it was celebrated for having erected immense glass works; it was obliged to emigrate, in consequence of the repeal of the edict of Nantes, and settled in Germany.

Two sons were born from the marriage of the Major von Humboldt with the widowed Baroness von Holwede. The eldest, William, was born in Potsdam, on

the 22nd of June, 1767, when the father was still chamberlain to the princess Elizabeth of Prussia; the younger son, Frederic Henry Alexander, the subject of our memoir, first saw the light of the world two years later, in Berlin, on the 14th September, 1769.

The castle of Tegel made the first impressions of home on the two boys; for here they spent the greater part of their youth together. To this castle is attached a mysterious legend, which Goethe alluded to in "Faust," to show his dislike for the enlightener Nicolai. The present Tegel is not the old one, but rather a new creation of its possessor, William, brother of Alexander, who commenced and ended his life here; and who built a house here, which, to preserve one old turret, rises in turrets from the four corners; and which, as it was once his tusculum, is now his grave. The old castle in which the two boys passed their youth was grey and antiquated. The contemporary of Humboldt, a Prussian commissioner of woods and forests, named von Burgsdorf, whose official residence it was, had beautified it by the laying out of nurseries and plantations, which were universally admired at the time, and the new owner had taken possession of the castle and outworks during this time. Tegel is separated from Berlin by a dark pine grove, and is situated in a beautiful neighbourhood north-east of an arm of the Havel, called the Tegel lake. On the southern shore are seen projecting the town and fortress of Spandau, and the declivities which bound the north-western shore of the lake are richly covered with trees and verdure, while promenades and gardens afford the most varied and charming views.

This castle had always been, while the old major lived in it, known for its extended hospitality; and the ripening boys not alone saw their father enjoy the honours of princely visits, but many an officer, statesman, or scholar, was hospitably invited and received. Thus, in May, 1778, Goethe, who had accompanied his duke to Berlin to a grand review, also visited Tegel; he walked one morning from Berlin over Schön-

hausen to Tegel, dined there, and returned to Potsdam over Charlottenburg. At that time he perceived there two merry boys of ten and eight years of age, but did not foresee in what an intimate relation in mind and heart he should one day stand to them, especially to the elder.

The education and first training of these boys took place at a time when the science of education was, with the sciences of antiquity and languages, one of the great questions of the day. The new methods of education which Rousseau especially advocated had quickly found adherents in Prussia. The prebendary Von Rochow set a cheering example of a practical reform in education; the well-known Gedike worked for it in Berlin, and Joachim Heinrich Campe, by birth a Brunswickian, at that time field chaplain to the regiment of the prince of Prussia in Potsdam, joined the movement of reform in education. Basedow and the Philanthropin, an institution in Dessau, taught tutors and professors after the new method of Rousseau, and it became a point of honour and of fashion, in the educational zeal of the age, for the higher nobility to take tutors who could unite the practical and the useful with the revival of the ancient languages, especially of the Greek The plan had been originated by Heyne in Göttingen, and Major von Humboldt also obeyed these influences. He recognised in the then field chaplain of the prince of Prussia's regiment in Potsdam, in Campe, a man much more qualified for educational than for theological duties, and, after he had been preacher to the regiment since 1773, he took him into his house in 1775, and confided to him the preparatory education of his two sons, William and Alexander. It may be imagined that Alexander, being then only six years old, could have less felt the influence of such a man as Campe than William, who was two years older; but his influence over both must be acknowledged, as the ideas of Campe were developed in gigantic proportions in both his pupils. Campe, in later

times, enjoyed the reputation of being the greatest philologist and critic of German style next to Klopstock, and he probably, in Major von Humboldt's house, devoted his attention chiefly to the study of languages, and it is not more than probable that this same Campe should have laid the first foundation in these boys, and aroused the spirit of research which never afterwards quitted them. But we must notice here another influence of the teacher on the life of his pupils, especially on the younger one. Campe had plainly seen that the mode of education and tuition till then adopted in families and institutions, only tended to develop the memory, not the mind, of the student; he opposed, from the first, the mechanical training of youth, and endeavoured to develop the susceptibility of the youthful mind and spirit by a perception of the world, of foreign natures, men and manners. Could not, then, this man, who edited Robinson Crusoe, and enriched the juvenile library with imaginative delineations of bold voyages, could he not, as Humboldt's first teacher, have influenced the imagination and the reason of his pupils, and laid the foundation in Alexander for his love for exploratory voyages in distant regions?

Campe did not remain for a long period in the intimate relation of tutor under the paternal roof of the Humboldts. His influence over his pupils, however, continued during his life, and the friendship between them remained a lasting one, and became more intimate again in later years. It is a well-known fact that Campe accompanied the elder of the brothers on a journey from Göttingen to Paris in the summer of the year 1789; but we could not ascertain with certainty whether Campe had made a journey through Germany and Switzerland with the two boys while he was yet their tutor, as has been asserted by Schiller's circle at Jena.

Campe gave up his appointment as tutor to the two boys in 1776, as his reputation for teaching was such, that, after the retirement of the celebrated

Basedow, he was appointed director of the Philanthropin at Dessau, and received the title of an Anhalt-Dessau commissioner of education. This appointment he fulfilled for one year, and left it to found his subsequently so celebrated private educational establishment at Hamburg.

Major von Humboldt had now to look out for another tutor, and in the beginning of the year 1777 his choice fell upon a youth of twenty years of age, who, without enjoying the reputation of his predecessor, excited great expectations in the major, which he faithfully fulfilled. His name was Christian Kunth; he was poor, and had to discontinue his academical studies from want of the necessary pecuniary means. But he possessed an extraordinary knowledge of German, Latin, and French literature, of philosophy and history, and a high order of intellect, joined to the habit of moving in aristocratic circles, which his position of teacher opened to him. By this means Major von Humboldt made his acquaintance, and took him into his house as tutor to his sons, which was at the time a mark of great confidence, and an envied distinction. The young man found his pupils of the respective ages of eight and ten years, and he succeeded in further developing and perfecting the talents roused in the mind and heart of his young charges by his predecessor Campe. He entered into a more intimate relation to them than that of teacher towards pupils; he bestowed more care upon them than that by which a teacher faithfully imparts his own knowledge to the mind of a talented or quick child. Kunth endeavoured to make everything within his reach in Berlin available and useful for the development of his charges. The success of his endeavours not only confirmed the confidence of the parents, but awoke in the youths a pure, unchangeable love for their teacher, and an affection and confidence which continued throughout his life to his death in an equal degree. Whenever Alexander was, in later times, absent on his voyages of discovery, or if the elder

brother tarried among the ruins of classical antiquity, it was always the faithful former teacher and later friend, Kunth, who administered their property with paternal conscientiousness.

Kunth conduced to satisfy and develope in his pupils the inborn love for universality of knowledge, but endeavoured always to unite it with profundity; and if Campe had awakened a wish for philology and cosmology in them, Kunth made it available by fundamental researches and universality. Both brothers, in obedience to their different natures, followed different branches of their acquirements, but both were rooted in the same foundation. The elder brother made humanity—its intellectual world, and its especial element, language—the task of his life. The younger, Alexander, took the outward part of nature and humanity in all its varieties. While the elder brother educated himself for classic antiquity, art, philosophy, and language, Alexander from the same origin directed his attention to natural sciences. Both frequently met and assisted each other in the points they originally had in common.

Kunth thus acted upon his pupils, but this intimacy could not fail to exercise a strong improving influence on him the teacher. The house of the chamberlain and Major von Humboldt united in itself rank, intelligence, cultivated acquaintance, and influence. Kunth, possessing the confidence of the family in the highest degree, was considered as one of its members, was entrusted with commissions in the execution of the practical affairs of the family and its public interests, and thus gained an experience in practical business which, at a future period, qualified him for an official position, as we shall see.

But a great blow afflicted the family in which Kunth had been tutor since 1777. In the January of 1779 the Major died, and the boys were without a father. The maternal voice now exercised a greater influence, and beside the noble confidence which the widowed lady showed Kunth, by giving him all but

paternal rights over the boys, it was the highmindedness of the lady which beneficially ruled the whole household, and inspired an enthusiastic love for her into the hearts of her children, whose education was her chief care.

Another intellectual influence was now brought to bear on the two youths. Since 1776 a physician had lived in Spandau, who soon after became district physician of the Havel district, and had an extensive practice. This man was Doctor Ernst Ludwig Heim, since become so famous as doctor and professor of the University of Berlin. Probably the major's illness may have been the origin of his acquaintance with the family; we know only that as doctor to the family of Humboldt and of the headranger, Von Burgsdorf, who, as a royal official, had to live in Tegel, he frequently came from Spandau to visit the neighbouring castle and village. He also communicated many of his experiences of foreign trees and the nursing of foreign plants to the ranger, and made himself useful in the laying out of the nurseries and plantations there. His frequent visits to the Humboldt family commenced in 1780, when he entered into a nearer, more intimate friendship with Kunth, the tutor of the household. These visits, which Heim made on horseback, and which generally brought him to the dinner-table of the major's widow, became of importance to us in the following year, when Heim instructed the two boys, William and Alexander, in botany after dinner, and explained to them the twenty-four classes of the Linnean system. An expression Heim used at the time is remarkable, namely, that the elder boy easily comprehended these lessons, and retained the botanical names, while Alexander, then eleven years of age, was of a less intelligent nature, a phenomenon which was confirmed by the anxiety which mother and tutor at one time felt that Alexander was not at all fitted for study.

The brothers made short excursions in the neighbourhood with the physician Heim; and we know

that, in 1783, on the 19th May, when Frederic the Great annually reviewed his troops in Spandau, and the entire population was on foot, Heim with the Tegel friends—Kunth and his two pupils—were present at the review. Heim resided in Berlin in 1783, and must therefore have brought his friends from Tegel, or have met them in Berlin.

About this time the brothers were sent to Berlin with their tutor, in order to continue their education with the better opportunities of the capital. William, the elder, occupied himself principally with languages, and as neither he nor his brother visited any of the schools, teachers were engaged and selected by Kunth, to complete the special instruction he had commenced. Alexander generally participated in William's lessons, but was less strictly urged to study, because he was physically weaker than his brother, and learning was more difficult for him. Not till an advanced period of his boyish life did a light suddenly shine in his mind, and then he had to make greater exertions than his brother to keep pace with him in their common studies. Alexander was indeed delicate and nearly always ill, even in his university years, and it was therefore natural that Kunth should be less strict in inciting him to study, especially as he still doubted his abilities when he compared them with the rapid acquirements of William. Alexander, at a subsequent period of life, ascribed his weakness to an excess of unhealthy secretions which accumulated in his frame, but his friends, among others Forster, assure us that Alexander's bodily ailments only arose in consequence of the premature activity of his mind, and that this excessive activity was caused by his desire to equal his brother in knowledge and acquirements.

They received instruction in the Greek language from Löffler, at that time field chaplain to the Berlin Gensd'armes regiment, who had already published a rationalist work on the fathers of the church and on new Platonism. He was succeeded by a certain Fischer of the grey cloister, in Berlin, who was known

chiefly as a mathematician, but who possessed a considerable knowledge of Greek. The philological talent which already showed itself in the elder brother, induced them to learn modern as well as classical languages, while in consequence of the love for natural sciences which Alexander felt, young Wildenow was engaged to instruct him in botany. Kunth endeavoured to prepare his pupils, who had now grown up to young men, for their future academic life in a worthy manner, by private lectures on scientific subjects. He engaged such men as Engel, Klein, Dohn and others, who gave the brothers complete courses of lectures on philosophy, law and political economy; and particularly Dohn, who was in the department of foreign affairs, gained a considerable influence over them. The minister Schulenberg had requested him to give a course of political economical lectures to a young count Arnim, and, in obedience to the wish of their mother, the Humboldts also joined this course, which lasted from the autumn of 1785, to the June of the following year, and which resembled the university classes. These lectures of Dohn, which were carefully composed on a special plan, brought him into a more intimate relation with the Humboldts, and this friendship continued unchanged when they had arrived at a more matured age.

But now the individual peculiarities in the character of the brothers began to show themselves. The impression made on the sentimentality of the nation by the formerly published "Werther" of Goethe received new nourishment from the highflying enthusiasm of Schiller's Don Carlos. The whole educated world revelled in feelings and ideals, and sentimentality belonged to the tone of the educated class, especially to the younger portion of it. The young William particularly was influenced by this tendency, which was increased by his associations, for, by his companions in his dancing lessons he was brought into nearer relation with ladies, who, by their subsequent intellectual standing, show what a sentimentalising impression

they must have made on a susceptible youthful nature. Among them were Fräulein von Briest (married first to Von Rochon then to Von Fouqué), then the well known Rahel, and Henriette Herz as beautiful as she was intellectual, to whom William stood in almost fraternal relation. This sentimentality of the elder brother, which characterised him at the university, and which slightly tinged his future life, a sentimentality which, united to intellect, showed itself especially in the Jewish circles of Berlin as an echo of the age of Mendelssohn, found less susceptibility in the physically delicate Alexander. Although this sentimentality of the feelings even infected his tutor Kunth, his mind developed its natural observing faculties, and he already studied the ways of nature, for whose phenomena he evinced an anxiously inquiring mind. While William was pursuing the æsthetical studies of the age, especially those of Schiller and Goethe, Alexander followed the researches into natural history of Goethe, and endeavoured to make his knowledge applicable to the better understanding of natural phenomena.

Thus the two brothers passed an exciting, happy time of their early education as youths, partly in the capital so rich in the means for education, partly under the domestic influence and protection of their beloved mother, on their family estate of Tegel; and their descent from one of the noblest families, as well as their own reputation, easily opened the richest sources of knowledge for them. Herein the two brothers are favoured children of fortune, for they never suffered from temporal cares, from that fainting of the spirit, thirsting for knowledge, and that striving for opportunities to apply the acquired knowledge which oppresses, and sometimes quite destroys, a poor youth of talent coming from an obscure family. Another feeling which remained strong in the brothers during their whole life, and which probably took its origin at this period, is their Prussian patriotism. Before their childish imagination, the person of

Frederic the Great stood a glorious picture of their native land, and in him the reformation and glory of Prussia were personified. The king died when the brothers were on the point of leaving Berlin to attend a university, and they therefore were not witnesses of the weakness, the political and moral dissolution which came hand in hand with the stupid rage for a reason reformation which the successors of Nicolai spread over Berlin.

The brothers entered on their academical life together as they had made the preliminary studies together. The university of Frankfurt on the Oder, which at that time enjoyed a great and wide-spread reputation, was chosen for their further education, and the commencement of their special studies. In the year of the great king's death, in 1786, they departed with their tutor and friend Kunth, with the intention of remaining there nearly two years, till the Easter of 1788. William devoted himself to the study of law; but Alexander, in obedience to the natural tendencies which were developing themselves with increasing force, chose the study of political economy, as it seemed to him most nearly allied to his scientific inclinations. Their former teacher in Berlin, Löffler, who had since become professor in Frankfurt, took the brothers, with Kunth, into his house; and, while they each followed their special studies, they pursued their philosophical, philological, and natural historical studies in common, for William took special interest in the latter.

The choice of the university of Frankfurt was probably the mother's, who wished to keep her sons near her, and not lose sight of them so quickly; therefore Kant, the celebrated philosopher of the age, who lectured in Konigsberg, did not influence the choice of the university with the widow of Major von Humboldt. The mother's real intention was to send her sons to Frankfurt as a preparation for their future public life, but to let them attend Göttingen, the most celebrated university of that time, for their final edu-

cation. Leipzig and Halle had already lost some of their fame, and Jena only reached the zenith of its glory at a later period.

In Frankfurt, Count Dohua, who studied here from 1786-88, became an intimate friend of the brothers Humboldt; but he attached himself more to the elder brother, in consequence of his studies being principally classic; and William, as well as Rhediger, exercised a lasting influence over him here, and met him again at a later period in Göttingen.

For Alexander nothing could have been more agreeable than the removal to Göttingen, which took place in 1788; for at Göttingen lived that great man in the branch of science for which he felt more and more an innate tendency; here lived and taught BLUMENBACH, the celebrated natural historian, who, with his strong mind, arranged and comprehended all the features of natural history according to form and existence; here lived HEYNE, the teacher and reviver of archæologic science; and here lived EICHHORN, the historian.

Archæology and history were the domains of learning on which the two brothers worked in common; the classical antiquity, with its philologic and artistic studies, attracted both; history in its philosophic view, interested William, and served Alexander to collect materials for cosmography and ethnology. While William made himself more intimate with classic literature, and the writings of the philosopher Kant, Alexander gave himself up to the instructive and personal influences of Blumenbach, but both brothers found a common point of union in the congenial intercourse with Professor HEYNE, who soon esteemed the young men highly, and exercised a great influence on their future studies.

Alexander here formed a new and lasting incitement in the acquaintance and quickly-cemented friendship with GEORGE FORSTER, HEYNE'S son-in-law. This man had formerly accompanied Cook in his journey round the world in the capacity of natural

historian, it was therefore natural that he should be an attraction for Alexander, whose phantasy was filled with images of a transatlantic strange world, which Campe, the editor of "Robinson," had awakened in him, and the longing for the personal knowledge of fabulous districts, for bold sea journeys and new discoveries was excited in him, when Forster told of his journey round the world. Thus Forster was the first portentous individuality, surrounded by the mysterious halo of a transatlantic journey, who became more closely allied to ALEXANDER VON HUMBOLDT. He was a man of boldness and fertility of mind, full of a holy striving for liberty, whose inborn love of freedom had been increased by his early journeys to a new world, and could ill-domesticate itself in the narrow German boundaries, and who was at the same time a determined opponent of the enlightening rage then prevalent in Berlin. The brothers Humboldt had, from their childhood, remained far from any contact with the littlenesses of Prussian officials, but cherished a true patriotism from their liberal ideas, developed in the vicinity of an intelligent monarch; the free ideas of Forster, his bold spirit, and his racy unprejudiced manner of thinking, had therefore a lasting influence on the young friends, and founded and developed, especially in Alexander's character, that feature of citizenship which is one of his noblest characteristics. During the summer of 1788, Forster lived with his wife at the house of his father-in-law, Heyne, in Göttingen, and in the autumn of that year he went to fill his new appointment at Mayence, where he was councillor and librarian of the university then existing there. That he made an impression also on the elder brother William would be alone proved by the fact that soon after Forster's removal from Göttingen he stayed with him four days on the occasion of a Rhine journey.

Both brothers sought and valued Forster's acquaintance, and entered into an intimate friendship with

his wife, a being as intellectual and cultivated as she was amiable. The intercourse with Johann Stieglitz, whom they knew, from Berlin, where he had belonged to the Jewish circle of the Mendelssohns, Herz, &c., and where he had pursued his philosophical studies, was less attractive to Alexander than William. It is strange that Stieglitz should have entered into the sentimentality of those circles, as his biographer truly states that he was only a man of reason, that he overcame and concealed all emotions for the purpose of acute calculation and observation, and that he never "forgot" himself. It is probable that his intimate friendship for William had its more natural origin in the fact, that Stieglitz had in Göttingen saved him from drowning in the Leiné while bathing there.

After a lapse of two years the time arrived when the brothers were to leave the university. Alexander had in the meantime uninterruptedly devoted himself to natural history, archæologic, and philologic studies, under the personal superintendence of celebrated professors; William had made many journeys during the time; among others to Hanover, where he met Fried, Jacobi, Rehberg, Frau von Wangenheim, Brandes, and Zimmermann. Kunth was no longer with them; he had entered into official service, but lived in the house of Madame Von Humboldt for nine years, until her death, when her unqualified confidence entrusted him with the further direction of her family affairs.

But the brothers were now so far advanced in manhood that their peculiar mental qualifications were individually characterised. Alexander had a tendency for great universal studies with his comprehensive understanding, while William liked to tarry longer on a narrower limit, and in a more profound study of that limit he settled himself on the circumscribed spot for the time to make similar profound researches on another field afterwards.

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CHAPTER II.

PRACTICAL APPRENTICESHIP—CIRCUMSTANCES—EARLY WORKS—PLANS OF TRAVEL, AND HINDRANCES.

In the second half of the year 1789 terminated the university life of Alexander as well as of his brother, in so far as it related to a higher comprehensive preparation for their future offices. But neither of the two brothers returned home; they obeyed a specific impulse of their individual nature, and entered at once into their life and intellectual pursuits, which were henceforward to diverge, even if in their tendency they were spiritually allied.

The breaking out of the French revolution affected the elder, William, educated for political life, more forcibly than Alexander, who calmly observed nature in its immutable laws. When, therefore, their first tutor, Joachim Heinrich Campe, who for some years had been canon and councillor in Brunswick, determined in July 1789 to run over to Paris, in order, as he expressed it, to be present at the funeral of French despotism (a wish in which he was bitterly deceived), he found, in addition to another young man, a companion in William von Humboldt, and arrived in Paris with him on the 3rd August. During that period Alexander lived for natural sciences, and his mind was directed to the extension of his knowledge of the earth, which made travelling his dearest wish, and this was fostered by his constant correspondence with Forster. It was particularly the formation of the earth which interested Alexander; he felt himself confirmed in his tendency by the reputation of Werner,

the celebrated geologist, and had made this field of natural science the favourite object of his studies. We, therefore, in the spring, 1790, with FORSTER and a certain VON GEUNS, find him making his first scientific journey to the Rhine, through Holland, and to England; and this first experience became the subject of his first literary production. It appeared in the same year under the title "Mineralogical Observations on some Basaltic Formations of the Rhine," and was intended to furnish the proof that this mineral was of neptunic origin, and that its formation, therefore, dated from the great water phenomena of the earthball. Forster collected materials on this journey for his splendid work, "The Views of the Lower Rhine."

It may with certainty be presumed that Alexander von Humboldt prepared himself for this journey with Forster from the winter of 1789 to the spring of 1790. We deduce this from his earnest striving after knowledge, and from the fact that this was a journey undertaken for scientific researches; he, therefore, spent a much more intellectual winter than his brother William, who enriched himself in a more genial manner. And here the difference between the two brothers becomes very evident, for while William, the elder, sought the life of society, and susceptible to all the impulses of higher feelings, early entered into ties of importance for his whole life, Alexander had neither found food for these phases of his soul, nor sought the opportunity, but had steadfastly kept to the one great plan —to found a future position by faithful researches into the spirit of natural life. William, urged by the enthusiastic feature in his character, *enjoyed* already the advantages of an æsthetic, select circle, but Alexander *studied* in his quiet intercourse with that world whose eternal laws were to become intelligible to him. While he devoted himself to the geologic and mineralogic preparatory studies for his first journey, and to a correspondence with Forster, prompted by the noblest friendship, William lived partly in Erfurt, in the society of the Baron Dalberg, especially in the

family of the president Von Dacheröden, with whose beautiful and intelligent daughter he betrothed himself, and partly in Weimar, where he made the acquaintance of Schiller through that family, and in consequence of his betrothal soon became his friend.

It is possible that Alexander's preference for a quiet spiritual intercourse with nature, whose secrets attracted him, may have been partly caused by physical reasons, which made him less qualified for the circles of society, which his brother frequented. He was still delicate, and had suffered much during the last five years, and the fear of being hindered by physical weakness from pursuing the great plans of his mind, induced him to satisfy all the physical demands of his nature, and thus prepare himself slowly for his great travelling plans which had inspired the imagination of the boy, and which had been matured, through Forster's influence, to his favourite idea and the purpose of his life.

But the practical course which he had chosen as his special department, had to be followed as consistently as his elder brother followed his. The latter was appointed councillor of legation and assessor to the court of Berlin, to make a trial of his capability, after which he intended to marry. Alexander, who had chosen the department of finances, wished now to prepare himself for a speedy entrance upon official life. The mineralogical studies, which had delighted him more and more, and which had become more attractive since his journey with Forster, excited in him the wish to make the mining department the special business of his life and of usefulness to the state. He therefore, in the same year, went to Hamburg to the commercial academy, under the direction of Ebeling and Busch, where he studied the practical part of bookkeeping, but occupied himself with mineralogy and botany besides. It is related, that in the winter of 1790-91, he often went out to seek mosses, which only grow in winter. His frame of mind here was a sign of the return of his physical strength, and conse-

quently of his more realizable hopes for the great travelling plans ever present to his mind's eye. He was, at this time, as industrious as he was cheerful, and Forster himself calls the letters written to him at this time, witty, full of humour, goodness and sensibility. Among his associates we must mention especially Christian Stollberg.

But Alexander did not stay long in Hamburg. His love for natural sciences, especially for geognosy (the science of the composition of the earth's surface) and the reputation of WERNER, director of the mining academy of Freiburg, who had introduced a new theory of geology on scientific principles, and who was at the same time the greatest geognost of the age. excited the wish in Alexander von Humboldt to go there likewise, and study the metallurgical sciences. In addition to this great inducement, it happened that a young man named Leopold von Buch, of Berlin, who, though younger, had formerly been intimate with Humboldt, in consequence of his interest in botany, was also studying mining, and was already in Freiburg. Humboldt therefore removed to Freiburg in the spring of 1791, and became a student at the mining academy at the same time that his brother William had determined to give up his official activity for a time, to retire from public life, and to devote himself to higher studies beside Caroline, whom he was soon to call his wife. When Alexander left Hamburg, he hastened to Berlin to enjoy the society of his mother, his brother who was remaining here until the summer, and his friend Kunth. He remained here till July for the recreation of his health, and for the preparations for his plans, and then went to Freiburg to his mining studies, where he devoted himself until March in the following year, with especial zeal to the sciences of mining and metallurgy.

With the spring of 1792, he entered upon his civic and literary sphere. He was about this time appointed assessor to the mining and smelting departments of Berlin, but was in the same year removed to

Bayreuth as superintendent of mines in the newly acquired Franconian districts, with the official commission, entirely to remodel the mining operations there.

The Baron von Hardenberg, who subsequently played such a prominent part in the Prussian administration, and with whom William von Humboldt entered into such a peculiar connexion and opposition, was, at the time when Humboldt came to Bayreuth, a young provincial minister of the Franconian principalities, and soon became an intimate friend of the young superintendent, by whom he was introduced to William von Humboldt in the following year.

As superintendent, Humboldt was at the same time general director of the mines in the principalities of Bayreuth and Anspach; and his indefatigable industry was directed, beside his scientific labours, to the erection of public institutions in these districts. He filled this position till 1795, when he voluntarily resigned it; his soul, during the whole period, worked secretly at the plan of a great voyage of discovery, but his immediate neighbourhood and the opportunities of his position called forth a multitude of learned works and practical observations, which spread his reputation as a clever naturalist. He employed himself much with various experiments on the physical and chemical laws of metallurgy, and took a considerable share in the dissemination of the theory of his teacher, Werner, who was an eminent supporter of the so-called Neptunismus in the formation of the world, and consequently ascribed all the formations of the solid earth crust to the influence of the waters. Alexander von Humboldt's treatises on these subjects may be found in the "Mining Journal" of VON MOLL, in Köhler and Hoffman's Journal, in Crell's Chemical Annals, as well as in the chemical and physical journals which Gren, Scherer, Gehler, Gilbert, and Poggendorf edited at that time; he also worked industriously for the French periodicals, "Journal de Physique," and "Annales de Chimie." In these treatises he laid down the foundation of his subsequent riper observations

and more fertile experiences; for as he never treated cursorily, or isolated any material for general knowledge, he afterwards incorporated these youthful productions in a larger sphere, and we find them nearly all corrected and enlarged in his large works of travel, written at a matured age. A more considerable work, written in the year 1793, appeared under the title, "Floræ Freiburgensis Specimen," or "Flora of Cryptogamic Plants of the neighbourhood of Freiburg," in which he publishes the result of his observations of the mines of the district, made during his residence there, especially of the fungi growing in the shafts of the mines. These were appended to his Aphorisms from the chemical physiology of plants, which contain his experiments on the susceptibility of plants, their mode of nourishment, their colour, &c., and give a number of observations and opinions, which are still, after the immense progress the science has made in the last fifteen years, very valuable, and reveal the clear, penetrating power of observation of their author.

In 1794 he accompanied the provincial minister, Von Hardenburg, to the Rhine, whither a political mission had called him. This journey revived his longing for the realization of the favourite plan of his life, and he endeavoured therefore to realize his larger journeys by smaller ones. He accordingly prepared for his projected journeys by tours through the Alp districts and Silesia; and his love of travel was partially gratified by an order he received from the government to make a trip into the province of Prussia and Poland, in his official capacity.

Although Humboldt's position was a favourable one for the cultivation of his favourite science, it did not suffice for his active mind, thirsting for an unknown world. From his youth upwards it had ever been his plan to make Transatlantic voyages of discovery, and on this plan he concentrated all his vigour.*

* Humboldt says of himself: "I had from my earliest youth felt a burning desire to travel in distant lands unexplored by Europeans. This desire characterizes a period in our existence in which life ap-

In the year 1795, he resigned his office of master of the mines, and went to Vienna, where he associated with the famed geognost Freiesleben, employed himself with botany, especially with the study of an excellent collection of exotic plants which he found here, and planned a journey into Switzerland with Freiesleben. His purpose was now to see Italy, especially the volcanic districts of Naples and Sicily. He went there with a Herr von Haften, but had to limit his plans to Upper Italy, without being able to reach the volcanoes, on account of the war. It was at this time that the great discovery of GALVANI—the discovery of that natural force which in our times has afforded such important practical results, and which was called galvanism, after its discoverer—was studied with great interest by Humboldt, and was variously experimented upon by him.

But his scientific industry received many sad checks about this time. His beloved mother had suffered from increasing delicacy for some months; his brother William, who, after an agreeable stay in Jena in 1794, had, with his young wife, entered into intimate social and intellectual relations with Schiller and Goethe, the philosopher Fichte, the historian Woltmann, the philologian councillor Schütz, the professor and antiquary Ilger, the theologian Paulus, the doctors Stark and Hufeland, &c., wrote to him in 1795, to Bayreuth, that he had in the month of June found his mother ill in Tegel, and had therefore postponed his intended return to Jena that winter. Now

pears to us as an unbounded horizon, where nothing has greater attractions for us than strong emotions of the soul and physical dangers. Brought up in a country which has no immediate connexion with the Indian colonies, and subsequently an inhabitant of mountain districts, which, far from the sea shore, are famed for their mines, I felt a violent passion for the sea and for long maritime voyages develop itself in my soul. All objects which we know only by the descriptions of travellers have an especial charm: our phantasy is pleased with whatever appears infinite and unlimited. The enjoyments we have to renounce seem to us to have greater charms than those which fall to our share in the narrow circle of our quiet life."

in the beginning of December, Alexander received the sad news from his brother, who had since the end of April 1796 returned to Jena, that their mother had died on the 20th of November.

This news, and the family affairs consequent thereon, called him away from his scientific and travelling plans for a short time, and in the beginning of the year 1797, he came to his brother to Jena, where he found William's wife ill in consequence of the birth of her second son.

He remained here until the spring, but the great plan of a West Indian journey had been so far matured, that he employed the time of his stay at Jena entirely with preparations for this important scientific undertaking. He found Freiesleben here, and entered into more intimate relations with Goethe, who had arrived there on a visit, and his practically-continued anatomical studies excited his brother William's and even Goethe's interest for them to such a degree, that the former heard private lectures on anatomy from Professor Loder with him, and Goethe often and with pleasure conversed with him on zoological preparations. Besides this, he continued the experiments on galvanism he had commenced at Vienna, and turned his attention chiefly to the laws of muscular irritation, and the disposition under galvanism of living nerves in living animals. He saw here a phenomenon analogous in many points to galvanism, and composed another work which gave new explanations on the efficacy of galvanic chains of animal substances on the susceptible muscular and nervous fibre. The interest in the development of this force in living animals continued, and we shall see how he makes observations during his travels on the peculiar development of electricity in the so-called electrical fish. A work on a similar subject which he had prepared in Jena, he could not publish himself, as his anxiety to commence his journey made him impatient of the necessary delays; he sent his manuscript to Blumenbach in Göttingen, who pub-

lished it with his own notes. In spring he left Jena, full of the plans for his West Indian journey. His friends there parted with him unwillingly, for even Goethe, who had been there only a short time on a visit, and had returned to Weimar in April, had experienced the instructive influence of Alexander's presence, and wrote to Schiller: "I have spent the time with Humboldt agreeably and usefully; my natural historic studies have been roused from their winter sleep by his presence."

Alexander's fondness for travel found a willing sympathizer in his brother William; they spoke only of travels, and dreamed of distant countries, and Schiller wrote at this time (14th April, 1797) to Goethe: "Although the whole family of Humboldt, down to the servant, lie ill with ague, they still speak only of great journeys." For the brothers had made the plan to travel together to Italy, after a short stay in Berlin for the regulation of the mother's inheritance, and from there Alexander was to go to Spain, and thence to America.

At the end of April, Alexander and his brother William with his family left Jena. To accommodate the latter, who wished to have some verbal communications with Wolff concerning an intended translation of "Agamemnon," he remained for some days in Halle, and then hastened to Berlin, to arrange the affairs of the inheritance, with the assistance of the faithful Kunth, in such a manner, that he was prepared at once for a long absence from Europe. The estate of Ringenwalde, in Neumark, had fallen to his share, while the elder brother took possession of Tegel, but he wished to sell it, that he might with the proceeds realize as soon as possible the project of his West Indian journey, which he had cherished for seven years, and which was an expensive private undertaking. The members of the Humboldt family therefore met in June in Dresden, where they regulated their affairs with the advice and assistance of Kunth, who had likewise joined them.

Alexander sold his estate to the poet Franz von Kleist, and confided the care of his property to Kunth, who also became manager of William's estates.

And now the long talked of plan of a journey to Italy together was to be realized. But a new delay took place; the intended stay of a few days grew to weeks—a relapse of fever of William's wife detained them all in Dresden. These premature delays in the long considered great plans induced Schiller to write to Goethe on the 23rd July: "That will be a fine journey! They must now already stay above their time in Dresden!" But their long stay was agreeably passed in the society of Körner, of the Russian ambassador, Count Gessler, and the great philologian Adelung.

But greater and more unpleasant delays were to detain them.

Alexander went with his brother and family to Vienna, but here already their intended stay of a few days was involuntarily lengthened, because they had to await the issue of the impending warlike demonstrations between Austria and Bonaparte, and these were still delayed. Here they made the acquaintance of a Westphalian family, Von Haften, and Alexander found in Herr von Haften a former friend, who, like him, interested himself for geology. Besides, they found the young naturalist Fischer, afterwards Russian councillor, and while Alexander bore the suspense consequent on the warlike events more cheerfully in scientific studies of nature, his brother William passed the time in the imperial library with the young philologian Bast.

But public affairs had now taken such a turn that a journey to Italy was no longer possible. For although the French had been almost driven out of the south of Germany in the former year by the victories of the Archduke Charles, yet Bonaparte's bold and victorious tactics had now gained other and more important advantages, for by his domination of the Adriatic provinces, and by other victories in Italy, he

forced Austria to negotiations which were considerably protracted, but which allowed no doubt of Italy's fate.

Under these circumstances the brothers were forced to give up their plan of travelling to Italy, especially when they heard that Goethe, who also wished to go there, could only for the same reasons proceed as far as Switzerland.

This news that Goethe was in Switzerland determined Alexander to realize his plan of a Swiss journey. As the family of Humboldt had determined to visit Paris, Alexander made up his mind also to accompany his brother thither. But then the events of the 18th Fructidor took place, by which the peace party was overthrown, and by which Austria was forced to accelerate the war negotiations by greater compliance. Schiller, who believed these French events would induce the Humboldts to give up their journey to Paris, was as much deceived as Goethe, who, being still in Switzerland, towards the end of September expressed his belief to Schiller that the Humboldts, after their journey to the Alps, would pass the winter very sociably at Jena. It was, on the contrary, the plan of the brothers Humboldt to draw nearer the French boundary at the foot of the Alps, and to await the hoped for conclusion of peace between Austria and the French republic here. Alexander intended in the meantime to give his scientific attention to the Swiss soil, so fertile and interesting for his geognostic studies.

The family, therefore, left Vienna in the beginning of October 1797, and Alexander accompanied them to Salzburg, where he met his friend and Freiburg fellow-student, Leopold von Buch, and soon renewed his scientific intercourse with him. As William, in certain anticipation of an impending peace, wished at once to continue his journey westward, and as Alexander was attracted by Leopold von Buch and the mountains, the brothers separated, and William travelled with his family to Munich, Basel, and, as the

peace of Campo Formio was concluded on the 17th October, to Paris, while Alexander wandered with Leopold von Buch for scientific purposes in the Alps of Salzburg and Styria, tarried some time in the mountains, and remained in Salzburg with his friend during the winter of 1797-98. They had to give up the idea of a trip into Upper Italy, in which Herr von Haften was to have joined them.

In the spring of 1798, Alexander left Salzburg and went to Paris, where his brother was still staying, whose house was the *point de ralliement* for all the educated Germans. But Alexander von Humboldt's arrival in Paris had higher plans; he wished to meet with opportunities for his great journey. In Salzburg already he had determined on joining an expedition to Upper Egypt, but the political events forced him to abstain. He had met with a man who was passionately devoted to the fine arts, and whose soul was longing for a journey to Egypt. This man, who had before been on the coasts of Illyria and Greece, had made the proposal to him to examine the old monuments along the Nile as far as Assuan for a period of about eight months. Humboldt made the condition that he should continue the journey over Palestine and Syria on their return from Alexandria. The promoter was very anxious for Humboldt's company, as his accurate knowledge of the classic nations of antiquity, which he had acquired about this time for this journey would be of infinite service to him. The political aspect of Europe destroyed this plan also. But his ardent spirit was not discouraged by these disappointments—his projects remained unaltered. He still had the plan of visiting the American continent; it was the purpose of his life, and he had, since his eighteenth year, prepared himself for it by shorter travels in Europe, in order to be able to compare his geological experiences in the formation of America, and to gain the necessary practical knowledge of the instruments calculated to assist such researches as he anticipated making. Thus intellectually prepared he

was, at the same time, in possession of the pecuniary means requisite for such gigantic plans; his striving soul, placed by a favouring fate in the happiest circumstances of life, knew not the wants and privations which often retard the most distinguished men in the execution of their plans, and delay their development and usefulness. He experienced some disappointments which could not destroy his hopes, but only delayed their fulfilment for a short time.

When the Egyptian journey was given up, Alexander von Humboldt heard that the national museum in France was preparing an expedition which, under command of Captain Baudin, was to make a voyage of discovery to the southern hemisphere. His anxiety to examine unknown countries drove him quickly to Paris to join the expedition, if necessary, at his own expense. With this intention, he came to his elder brother in Paris. Two naturalists, Messrs. Michaux and Bonpland, were appointed for this expedition, to direct the scientific researches; and Humboldt's first care was to make their acquaintance. He became more especially intimate with Aimé Bonpland. This young man was one of the most distinguished students of the military college, and of the botanical gardens of Paris, and found a congenial friend in Humboldt. Humboldt's participation in the expedition was welcome, and the scientific preparations for the great undertaking were zealously made by him. He learned Arabic, which called his brother's attention to the study of American languages; he became acquainted with the most eminent naturalists and mathematicians of Paris. His "RESEARCHES ON THE COMPOSITION OF THE ATMOSPHERE," which he had commenced alone, he continued partly with the assistance of the celebrated natural philosopher GAY-LUSSAC, with whom he undertook eudiometric investigations of the chemical analysis of the atmosphere, repeating them at all seasons, and in all temperatures, and by which he rendered important services to a juster knowledge of this subject. These learned studies

were founded on others which he had no doubt commenced before, during his official and scientific relation with the mines, namely "on subterranean gases," which he must have finished here in Paris, beside his other chemical labours, as the work was published at the commencement of the following year, when he had left the country.

But at the commencement already of his great journey under Capt. Baudin, he experienced a painful disappointment. The threatened resumption of a war with Italy and Germany destroyed the intended expedition to the southern hemisphere, as the French government needed the funds appointed for the purpose. Humboldt's determination to accompany an expedition of French learned men to Egypt, could also not be executed, because, after the battle of Aboukir, which the French lost to the English under Nelson, the communication with Alexandria ceased.

But Alexander von Humboldt had made the journey to another quarter of the world such a firm purpose of his life, that repeated disappointments could not disturb him in his preparations for the undertaking; he therefore continued to collect the necessary materials and knowledge for the journey, although he had to wait again for another opportunity. In Bonpland he found a congenial spirit, for he also was determined, at all hazards, to explore unknown regions.

In the autumn of the same year, Humboldt made the acquaintance of the Swedish consul Sciöldebrand, who passed through Paris with the intention of going to Marseilles, where he was to embark on a Swedish frigate, which was expected there in October, and go to Algiers on a special mission. Humboldt thought he had at last found a suitable opportunity for commencing a scientific journey through Egypt and Africa, and Bonpland offered to accompany him. They proposed subsequently to join the caravan to Mecca, and to go to East India across the Persian sea. As the Swedish ambassador promised them the sea passage, they soon made a plan for their journey;

they intended to examine the high mountain ridges of Morocco, and possibly to join the learned men who had accompanied the French army to Egypt.

Towards the end of October, 1798, Humboldt left Paris, and went to Marseilles, to await the Swedish frigate. He was quite prepared, and accompanied by his friend and fellow-traveller Bonpland. The leave-taking between the brothers was a sad one, for both had been accustomed to live in intellectual intercourse with each other, and to be each the complement of the other. Alexander von Humboldt speaks thus of this separation: "I left my brother, who, by advice and by example, had exercised a great influence over the direction of my ideas. He approved of the reasons which induced me to leave Europe; an inward voice told us we should meet again. This hope alleviated the pain of a long separation."

But his cup of disappointments was not yet full; it seemed as if fate had determined to detain him on the European shores, or to let him seek another, better course. For two months he waited at Marseilles with his friend Bonpland, but the Swedish frigate, which was to take the consul to Algiers, did not come, and at last the news arrived that she had been injured in a storm on the coast of Portugal, and would arrive at Marseilles in spring.

Humboldt thought of a return or of a relinquishment of his plans as little as his friend Bonpland; they determined to spend the winter in Spain, to occupy themselves there scientifically, and to seek some other ship's opportunity in the spring, especially as a journey to Morocco for scientific purposes seemed scarcely advisable, disturbances having occurred in Tunis.

With the commencement of the year 1799, the two travellers started for Madrid, but the pilgrimage thither was at the same time a scientific excursion. Humboldt being furnished with excellent instruments for an exploring journey, determined the altitude and astronomic position of many important points, ascended

the peaks of the Montserat and ascertained the real altitude of the central plain of Castille; while Bonpland explored the vegetable kingdom, and culled rich fruits therefrom. Humboldt found the climate of Castille much colder than that of Toulon or Genoa; he found the heart of Spain covered with sandstone, gypsum, rock salt, and Jura limestone; the mountains in many parts overgrown with dates, bananas, sugar cane, and other plants indigenous to northern Africa, which yet did not suffer from the here prevailing winter cold.

In Madrid their travelling genius, which had hitherto frowned on them, suddenly turned in their favour. Humboldt found here the Saxon ambassador, Baron von Forell, who took great interest in his projects, recommended him and his companion to the liberal-minded Spanish minister, Don Mariano Luis DE URQUIJO; and by his intercession, Humboldt was introduced to the court in Aranjuez, in March. Here he found the opportunity of explaining to the king his scientific plans, and their probable advantages and practical utility, and was fortunate enough to incline the king most graciously in favour of his plans. He received the unusual royal permission to visit and examine all the Spanish possessions in America, without any limitation or inconvenient condition, and the minister promised him his mediation for protection and promotion of his plans. It is strange that the geographical discoverer of America, Columbus, and the scientific explorer, Humboldt, should both have been assisted in their journey by Spain. The joy which Humboldt and Bonpland felt at this sudden favourable turn of their circumstances so increased their ardour, that they determined to make use of the royal permission as speedily as possible. They therefore lost no more time in preparation, but left Madrid in the middle of May, to go to some harbour, and to explore Spain on the way. With this intention, they passed through a portion of old Castile, the provinces of Leon and Gallicia, till they came to the port of Corunna.

With overflowing joy Alexander communicated the near fulfilment of his long-cherished plans and wishes to his elder brother at Paris, and his descriptions of Spain, which were painted in the most glowing colours by the animated pleasure he felt, persuaded William von Humboldt to a journey there. Alexander must have described the beautiful Spain to his brother so attractively already in February, when he was still on his way to Madrid, for Frau von Humboldt wrote home at that time that her husband intended to go alone to Madrid, perhaps even to Lisbon, at the end of March, while she would remain in the Pyrenees with the children. The subsequent descriptions of Alexander, on his way from Madrid to Corunna, could not have been less attractive and less inducive to William's determination, for his journey took him past the beautiful mountain ridges and rocks of Gallicia, and the granite peaks of Corunna, where he made their formation a subject of interesting inquiries, and planned a pleasing picture of the breaches made by the sea, which must have violently separated these mountains which, millenniums ago, were united ridges and precipitous rocks. These descriptions, written in the charming style of an Alexander von Humboldt, were probably the cause that the modest plan mentioned by Madame von Humboldt in her letter was extended by her husband, and that the whole family commenced their pilgrimage to Spain in July.*

Alexander arrived in Corunna with his companion; but here another hindrance threatened to prevent their departure. The English had blockaded the

* William von Humboldt also wrote "Notes" on this trip, which clearly show the intellectual intimacy existing between the brothers. As Alexander everywhere, on his scientific journeys, turns his observation comprehensively to ethnographical, philological, historical, and philosophic subjects, which were properly William's sphere; so William, whose subjects were more the ideal and mental developments of life, has also given splendid descriptions of inanimate nature and of the world of reality. Both brothers show, in these conceptions, their common intellectual origin and education.

port, in order to cut off the communication between Spain and its colonies. The two travellers had recommendations from the Spanish minister and from the chief secretary of state to Don Raphael Clavigo, who had for some time been superintendent of the ports, but he could do nothing more than, in obedience to the commands of the minister, to make their stay as agreeable as possible, for they were obliged to wait until the blockading English fleet should permit their departure. A ship, the corvette Pizarro, was lying in the port and was intended to sail to Mexico and Havannah, but had been detained by the blockade. Clavigo advised Humboldt to go on board that ship, and wait for a favourable opportunity of putting out to sea. The travellers followed this advice, and as they were anxious for their valuable instruments, and expressed the wish also to visit the island of Teneriffe, Clavigo commanded the captain of the Pizarro not only to provide a safe place for Humboldt's scientific instruments, but also to stay at the above-named island as long a time as the travellers would require to visit the port of Oratava, and to ascend the peak of Teneriffe.

The few days which elapsed before their effects could be shipped were spent, partly in a classified arrangement of the plants collected in Spain, partly in correspondence, partly in short trips to the little town of Ferrol, situated at the other point of the bay, where they made experiments on the temperature of the sea and the decrease of heat in the superincumbent layers of water. By these experiments they found the result, so important to navigators, that the neighbourhood of a sand-bank is revealed before the lead can be made use of, by the quick decrease in the temperature of the water, and that the seaman can therefore perceive the approach of danger much sooner by the thermometer than by the lead. At the moment of departure Humboldt wrote a letter to Captain Baudin, in which he reminded him of the promise he had given, that if the delayed expedition

should still be realized, and he should steer round the Cape of Good Hope, Humboldt would join him either at Monte Video, Chili, or Lima, or at whichever of the Spanish colonies he might be. This letter had important consequences. Through false newspaper reports he learnt in that distant country that Baudin had really commenced his journey, and Humboldt, mindful of his promise, travelled with Bonpland to Portobello over the isthmus of Panama to the coasts of the South Sea, although he was at the time in Cuba, and thus made a journey of more than eight hundred (German) miles in a country which he had not intended to visit. We shall have occasion to revert to this.

A violent storm, which commenced with a high tide and a flood from the north-west, obliged Humboldt and Bonpland to interrupt their experiments, but became extremely favourable to them for their travels. The two English frigates and the liner which had blockaded the harbour were forced by the violent storm to quit the Spanish coast and make for the open sea; Clavigo's advice was to seize the opportunity hastily to embark their instruments and their luggage, and not to let the temporary absence of the English men-of-war pass without an attempt to leave. Humboldt and Bonpland immediately set sail, but were obliged, on account of the increasing west wind, to tack about for several days. At last, on the afternoon of the 5th of June, after having succeeded in eluding the vigilance of the English cruisers, they steered for the open sea, passed the Hercules tower, then the light-house of Corunna half-an-hour later, and in the evening, favoured by the fresh breeze, they reached the open agitated sea.

Humboldt's heart must have beaten joyfully when he at last saw his hope and his longing, cherished for nine years, and so frequently disappointed, on the eve of fulfilment; what must have been his feelings when, at nine o'clock in the evening, he saw the light of a fishing-hut of Sisarga as the last object on the

European coast, and which, in the increasing distance, was scarcely distinguishable from the stars which rose on the horizon! His looks and Bonpland's were involuntarily fixed on it. "Oh," he exclaimed, years afterwards, "these impressions will never be erased from my memory! How many recollections does not one bright spot shining unsteadily over the agitated waves in the darkness of night, and pointing out the shores of our native earth, recall to the imagination!"

CHAPTER III.

THE OPEN SEA—THE FIRST STEP ON A FOREIGN SOIL—TENERIFFE—CUMANA—EARTHQUAKES—DEPARTURE.

THEY sailed quickly; the sea current, propelled by the gulf-current which flows from the Azores towards the Straits of Gibraltar and the Canary Isles, and which drives round the waters of the Atlantic Ocean in a continual circular course of 3800 miles, occupied the attention of the travel-glad naturalists. An English cruising fleet seen in the distance, determined the captain to diverge from the originally-intended course during the night, still, however, steering towards the thirtieth degree south. Sea swallows and dolphins accompanied Humboldt so far. On the 11th of June he for the first time enjoyed the surprising appearance of the sea covered by an innumerable quantity of Medusæ, which passed the vessel with great velocity, and which, by their metallic lustre, formed an agreeable contrast to the azure-coloured ocean.

A first marine voyage fills such a mind as that of Humboldt's with new events, new views and experiences, every hour. During the night he saw Medusæ emit electric sparks at the moment when the act of catching them communicated to them a slight shock. Between Madeira and the African coast he perceived a perfect rain of shooting stars, which became more vivid the further south the ship sailed. This phenomenon, which is seen sometimes in the South Sea, in the neighbourhood of volcanoes, and in many parts of Europe, has been made the subject of especial

study by Humboldt, and has led to a new explanation of this periodically-recurring rain of shooting stars.

Humboldt and his companions found another greeting from their native land. A martin alighted on a sail, so exhausted, that it could be caught with the hand; it was the last, and, for the season, unusual messenger from the land, whom longing had urged across the sea.

New scenes of brilliant natural phenomena increased in the vicinity of the islands now rising on the horizon, when the sea was calm and the sky clear. Humboldt and his friend often spent a part of the night on deck; there they watched the volcanic points of the Canary island Lancerote, illuminated by the moonlight, with the beautiful sign of the scorpion twinkling above them, as the moon was gradually obscured by the midnight clouds rising from behind the volcano. Here they saw on the indistinct fading shore, fires moving to and fro, which fishermen, preparing for their work, probably carried about on the coast, and Humboldt was reminded of the traditional moving lights which the old Spaniards, the companions of Columbus, had perceived on the island of Guanahani the night which preceded the discovery of America. And this time the twinkling flame was a good omen for Humboldt, the scientific Columbus of modern days.

The travellers sailed past the small islands of the Canary group, whose appearance, with their shores, their blunt conical rocks and volcanic elevations, pleased them much, and whose sea furnished them interesting marine plants; a blunder of the captain, who mistook a basaltic rock for a fortress, and sent an officer to it, gave them the opportunity of landing on the small island La Graciosa. It was the first non-European soil which Humboldt trod on, and he has expressed his feelings on the occasion in these words: "Nothing can express the feeling of a naturalist when, for the first time, he stands on a soil which is not European. His attention falls on so many objects,

that he finds it difficult to classify the impressions he receives. With every step he thinks to find a new specimen, and in this frame of mind he often fails to recognise those which are most common in our botanic gardens, and our historic collections."

The celebrated peak Teyde on Teneriffe, from whose appearance Humboldt had anticipated great pleasure, was concealed by the mist of the atmosphere. As this rock is not covered by eternal snow, it is indeed rarely visible at a great distance, even though its sugarloaf point reflects the white colour of the pumice stone which covers it, as blocks of black lava and a fertile vegetation surround it. When Humboldt and his companion had arrived at Santa Cruz, on Teneriffe, and had received from the governor, in consequence of their recommendations from the court of Madrid, permission to make excursions in the island, they made use of it the same day, after having been welcomed and entertained in the most friendly manner in the house of Major Armiago, commander of a regiment of infantry. In the garden of their kind host, Humboldt for the first time saw the banana tree, hitherto only known from conservatories, the papaya (melon tree) and other tropical plants, growing in the open air. As, on account of the English blockade, the ship on which Humboldt travelled could only be permitted to remain four or five days, Humboldt and Bonpland hastened to reach the port of Orotava, and thence to take a guide to the peak. On the way, they met a quantity of white camels, which are here used as beasts of burden. But it was the ascension of the peak of Teneriffe on which Humboldt had fixed his greatest expectations. A beautiful road led from Laguna, a town situated 1620 feet above the sea, to the port of Orotava, and then a landscape of incomparable sweetness surrounded him. Date and cocoa nut trees cover the coast, higher up the mountains flourish dragon trees, vines cluster round the precipices, and the occasional chapels peep out between orange trees, myrtles and cypresses; all the walls are

overgrown with mosses and ferns, and while above, the volcano is covered with snow and ice, an eternal spring reigns in the valleys. Thus surrounded by a perfect paradise, Humboldt and his companion came to Orotava, and from here they wended their way towards the volcano, a stony path lying through a beautiful chesnut grove.

Teneriffe was indeed calculated, as the first tropical country which Humboldt saw, to heighten his love for travelling, and to cheer and encourage the mind. The naturalist Anderson, who accompanied Cook on his third voyage round the world, advised all the doctors of the world to send their patients to Teneriffe, where the beauty of nature, and the evergreen picture of the most fertile vegetation, would give peace and speedy recovery to the oppressed mind. And he has not said too much, for Humboldt also describes the island as an enchanting garden, and he felt the influence of this glorious natural picture with an inherent sense of beauty, although, to the eyes of geologists, the island appears only as an accumulation of interesting volcanic formations of different ages.

Humboldt ascended the peak with Bonpland, and made most interesting observations on its formation, its geological history, and the consequential circles of the vegetation surrounding it. But he made here one very important general observation, namely, that the inorganic forms of nature, such as mountains and rocks, resemble each other in the most distant districts of the world, but that organic forms, such as plants and animals, vary from each other. As Humboldt sailed past the coasts of this group of islands he seemed to recognise known formations of mountain, to be transported even to the Rhine shores near Bonn, while the forms of the animal and vegetable world change with the climate, and vary according to the depth or altitude of their position. The rocks, older perhaps than climatory influences, are the same in both hemispheres. But this diversity in plants and animals, depending on the climate, and the height of

the soil above the sea, aroused in Humboldt that great interest in the geographical diffusion of plants and animals, which, by his continued researches in America, made him entitled to rank as the first scientific founder of this study. How important the influence of altitude is on this propagation of plants he had perceived already during his ascension of the celebrated peak of Teneriffe. There he passed first through the regions of tree-like heaths, then he came higher up to a belt of ferns, higher still a wood of juniper and fir trees; over that was a plain two hours and a half journey in breadth, covered with Spanish broom, after which he came to the pumice-stone soil of the volcanic crater, where he was welcomed by the beautiful retama, with its sweet-smelling buds, and the wild indigenous peak goat.

It might have been expected that Humboldt would continue his geological studies here on the crater of a volcano, and he did so most successfully, for he collected new materials for his subsequent observations on, and explanations of, the volcanic influence in the formation of the earth, and the phenomena of earthquakes.

A glance at the sea and the coast showed Humboldt and Bonpland that their ship Pizarro was under sail, and this alarmed them much, as they feared it might prepare for departure without them. They left the rock as speedily as possible, and rejoined their ship, which had already waited for them to take its departure.

But Humboldt had gained important matter for his future discoveries during this short excursion. The group of Canary Islands had become an instructive book of infinitely rich contents, whose diversity in a small space necessarily led a mind like Humboldt's to further universal study. He felt the true mission of a naturalist, and the importance of special research. The soil on which we move in joy and sorrow is the most mutable, most active in destruction and reconstruction—a power rules in it which ar-

ranges and forms the shapeless, which chains the planets to the sun, which gives the living breath of warmth to the cold mass, which forcibly destroys the seemingly-complete, which a human being in his narrow sphere considers as a gigantic whole, and replaces it by new forms. WHAT IS THIS POWER? HOW DOES IT CREATE, HOW DESTROY? These were the next great questions which forced themselves on Humboldt's mind, and to whose scientific solution he determined to devote his life. "What is a day of creation?" he exclaimed. "Did one revolution of the world round its axis suffice for it, or is it the result of a course of millennium? or did the continent rise out of the water, or did the water sink into the depressions of the earth? Was it the force of fire or of water which raised the mountains, levelled the plains, and placed boundaries to land and sea? What are volcanoes? How did they originate, and how do they act?"

Teneriffe gave him the first answer. He perceived the truth of what he had already made the principle of inquiry,—to look upon all specialities only as the parts of an intimately connected chain of universal causes and effects, running through all the laboratories of nature, to find herein the cue in the apparent labyrinth of infinite variety, and therefore not to overlook the seemingly insignificant with carelessness, but rather to see the great in the little, the whole in the part. Seen in this spirit, the volcano of Teneriffe was for Humboldt a key to many great mysteries of universal life; he perceived the various means which nature applies to form and destroy, and he thus made the history of the single one the rule for the history of the universal. The fire of the volcano which he ascended on Teneriffe was long since extinguished, but its traces seemed to Humboldt as the gigantic letters in explanation of the tremendous element which once pervaded our earth, which broke through the earth's crust, which buried men, animals, plants, and towns, and which still propagates its veins in the

depth, to shake the earth here and there, or to explode with flame and glowing lava through its safety-valves, the volcanic craters. And Humboldt taught [redacted] to understand all this!

We will now follow the vessel on which Humboldt and his friend were travelling over the sea, on their course to central America.

On the way the travellers occupied themselves principally with the sea winds, which became more equable the nearer they approached the African coast. The mildness of the climate and the calmness of the scenery here, increased the charm of the journey; and when Humboldt had reached the northern regions of the Cape Verd Islands, the great swimming seaweeds attracted his attention: they form banks of marine plants, and are probably rooted in the bottom of the sea, as branches eight hundred feet long have been found. But the human mind has also its claims on such a long voyage; wherever the eye turns it sees waves, clouds, or sky; it longs for the sight of familiar objects. The ship's crew seeks a strange person,—it would like to hear a voice from a strange mouth—from another country. It is therefore always a joyful occurrence if another vessel passes; all rush to the deck; they call, ask the name and destination, sign to each other, and mutually vanish from each other's horizon. The scientific labours of Humboldt and his companion, spite of the rich matter of new and unusual things which every day brought them, could not repress the emotions of his mind. Humboldt also rejoiced to see a sail appear on the distant horizon, but he felt the first pain of the mariner when gradually the mast and the remains of a shipwrecked ship covered with seaweed hove in sight; the wreck floated on like a grass-covered grave: where might be the remains of those who expired in the destroying storm, with a last struggle for their life! These feelings involuntarily obtruded themselves on the travellers.

But a beautiful, inspiring sight awaited Humboldt. In the night of the 4-5 July, under the sixteenth

degree of longitude, he saw the brilliant constellation of the southern cross; and when he gazed for the first time on this sign of a new world, he felt with deep emotion that the dreams of his childhood were realized. What he felt at this hour of his life, he betrays in his own words: "When one begins to cast a look on geographical charts, and to read the narratives of travellers, one feels a kind of preference for certain countries and climates, of which preference we can give no satisfactory account in riper age. These impressions exercise a sensible influence on our plans, and we endeavour, almost instinctively, to approach nearer to those objects which have long had a secret charm for us. When I first studied the stars, I was agitated by a secret fear, unknown to those who lead a sedentary life; it grieved me to resign the hope of seeing the beautiful constellations which are situated near the south pole. Impatient to explore the equatorial regions, I could never raise my eyes to the starred vault of heaven without thinking of the cross of the south pole, and without recalling to mind the beautiful passage in Dante's 'Inferno,' in which he refers to it." The whole ship's company, especially those who had already inhabited the American colonies, shared the satisfaction which Humboldt felt at the sight of this constellation. In the solitude of the ocean, a star is greeted as a friend from whom one has been long separated; and above this, a religious feeling endears this constellation to the Spaniards and Portuguese, for it was the same constellation which welcomed the first mariners of the 15th century, when the stars of their native north vanished from before them.

But Humboldt was also to experience the terrible scourge of illness on board a ship, during the last days of his journey. A malignant fever broke out, which grew more serious the nearer the ship approached the Antilles. A young Asturian of nineteen years of age, the youngest of the passengers, died, and his death made a deep impression on Humboldt, partly

from the circumstances connected with his journey,—for he had undertaken it to seek his fortunes and provide for a beloved mother who had put her trust in him. Humboldt was sitting on the deck with Bonpland, and filled with sad reflection; the fever in the cabins grew more and more malignant; his eye rested on a desert, mountainous coast which the moon now and then gleamed on through the dark clouds. The slightly agitated sea glowed with a weak phosphoric light; nothing was heard but the monotonous cry of some sea birds seeking the coast; a deep silence reigned, and Humboldt's soul was filled with painful thoughts. All at once—it was about eight o'clock in the evening—the death bell tolled mournfully; the sailors knelt down to say a short prayer by the corpse of the youth, who the day before had been well and merry; it received the catholic blessing in the night, and was committed to the waves at sunrise.

With these mournful feelings Humboldt approached the shores of the land which had smiled on him in his boyish dreams, and to visit which, as the aim of his life, and as the bright image of tropical nature, he had so cheerfully set sail. But fate, which had hitherto only sent disappointments and obstacles in Humboldt's path, to induce him to wait for better and more fortunate opportunities, fate made the malady with which the ship was afflicted serve to produce an important diversion in his plans. The non-affected passengers, alarmed by the malignancy of the fever, had determined to land at the first port, and reach their original destination, Cuba or Mexico, by another opportunity. They induced the captain to run into Cumana, a port situated on the north-eastern coast of Venezuela, and there to land the passengers. This determined Humboldt also to change his route, to visit first the scarcely known coasts of Venezuela and Paria, and to proceed to New Spain afterwards. Here he could find the beautiful plants which he had once admired in the conservatories of Vienna and Schönbrunn, growing luxuriously and naturally on their

native soil, and there lay for him an irresistible charm in exploring the heart of this land, which was still a great mystery in the natural sciences. Humboldt and Bonpland landed at Cumana, let the ship which had hitherto carried them sail on, and thus the accidental epidemic on the ship was the cause of Humboldt's great discoveries in these regions—from the Orinocco to the boundaries of the Portuguese possessions on the Rio Grande. This circumstance may also have been the accidental cause of the health and the unendangered life which they enjoyed in these equinoctial regions, for a dreadful epidemic raged at Havannah, whither they would have gone but for their premature departure from the ship, and this epidemic carried off many of their travelling companions.

The voyage from Corunna to Cumana, which had lasted forty-one days, had been very fertile in physical observations for Humboldt and his companion. With the assistance of the materials already prepared by science he had made important observations on the temperature of the atmosphere. The material difference between the atmospheric temperature on the sea or on land, independent of the change of season and the locality, seemed remarkable to him ; he invariably found that the ocean was warmer than the atmosphere, and that the readjustment of the balance between the two elements was prevented by the winds, which hindered the absorption of caloric during evaporation, during which, as is well known, caloric is always discharged.

Humboldt made other interesting researches on the blueness of the sky. Not only was his eye gladdened by the splendid change of colour from the pale green to the brilliant yellow and red of the ocean sky, he did not, like an ordinary admirer of nature, only let the momentary impression at the sight of the azure tint of the high vault remain on his mind, but he thought seriously on the effect and cause of the phenomenon, and thus he was the first naturalist who has made scientific observations on the colours of the sky over

the seas of the equinoctial regions of the earth, where days and nights are equal. After Deluc had called attention to the blue colour of the sky in 1765, and had asked for its cause and conditions, Saussure invented an instrument in 1791, which he called a cyanometer-measurer of the blueness of the sky, by which the degree of the colour is shown on the tables, arranged on an ascending scale from the palest to the darkest blue. Humboldt made great use of this instrument on this voyage, and ascertained, by the colour, the degree of blueness, the accumulation and the nature of the non-transparent exhalations of the air.

For this purpose he watched the colour and form of the rising and setting sun, and ascertained by it the duration of fine weather, the strength or gentleness of the wind, and discovered a paleness or unusual diversion of the setting sun to be the infallible sign of an approaching storm. He used the instrument also to measure the colour of the sea, which is generally green, and here he also found changes which often turned the sea during fine weather from the deepest indigo blue to the darkest green, or slate grey, without any atmospheric change being perceptible. He proved also that the expression "the ocean reflects the sky," was a purely poetical, but not a scientifically correct one, as the sea is often blue when the sky is almost totally covered with light white clouds. Beside these observations Humboldt collected many new facts on the moisture of the atmosphere, and on the electricity and attraction of the magnetic needle.

Arrived at Cumana, a port in which the traces of an earthquake which had taken place eighteen months before were yet to be seen, Humboldt was introduced to the governor of the province by the captain, and received with great civility, while the fever-stricken passengers who were brought on shore found a touching sympathy and ready assistance from the inhabitants. When Humboldt had seen the shore, the town, the fortress, and the landscape in

general, in which the living ramparts of impenetrably-intertwined prickly cactus, and the crocodiles which live in the moats of the fortress and guard it, were a new and peculiar feature; after he had made himself acquainted with the customs of the inhabitants, which had many peculiarities, and might almost be called amphibious, as children and adults spend a few hours daily on the river Manzanares, where they put chairs in the water on moonlight nights, and smoke their cigars on the river, and even invited Humboldt to join in this pleasure; he directed his attention to the volcanic soil on which he was living, for Cumana was often visited by earthquakes. He studied the history of these earthquakes in order to find new views, and to be able to regulate the direction and extent of those shocks under a yet-to-be-discovered law. On the 9th August, 1799, he made his first excursion with Bonpland to the island of Araya, which in former times was famed for its slave-trade and its pearl-fisheries, and where, after wandering through a wood of torch-thistles, he came to a hut inhabited by an Indian family, where he was hospitably received and accommodated for the night, and then remained two days in the neighbourhood. He soon afterwards made a second excursion to the missions of the Chaymas Indians, a district filled with a wonderful animal and vegetable world, and a people living almost in the rudest state of nature. Here he wandered on a soil rich in springs, beneath trees of gigantic size covered with lianas (tremendous parasitical plants), down the valleys to the huts of the Indians, surrounded by sugar-cane, melon-trees, pisang, and maize. Describing his stay here, he says: "If a traveller enters for the first time the woods of Southern America, nature reveals herself to him in a surprising form. What he sees is little calculated to remind him of the descriptions which celebrated travellers have made of the shores of the Mississippi, of Florida, and other moderate regions of the New World. But here (in Central America) the traveller

feels at every step that he is not on the boundary, but in the centre, of the torrid zone. He does not know what charms him or excites his attention the most; whether it is the calm repose of solitude, or the beauty of separate varying forms, or that force and freshness of the vegetable life which distinguish the climate of the tropics. It seems as if the soil, covered with vegetation, had not room enough for its development. Even the trunks of trees are overgrown with a close green covering. If one would carefully transplant the orchides, the pepper or pothos-plants, which grow on a single locust-tree or on an American fig-tree, one might cover a large tract of land. The same creeping plants which grow on the earth, ascend also the summits of the trees, and extend their branches, a hundred feet from the ground, from one tree to the other."

How engrossingly and how variously must not these sights have impressed Humboldt's mind in this great vault of vegetation, and how they must have enriched his mind with new unknown forms of nature! Here for the first time he admired the bottle-shaped, artistically-formed nest of the Oriola, the thrush-like bird, whose somewhat hoarse cry is so penetrating that it is heard above the sound of gushing waterfalls. On this excursion he saw the monastic life of the here existing mission, whose old prior smiled superciliously at Humboldt's researches, experiments, instruments, and dry plants, and maintained that of all the pleasures of life, not excepting sleep, none could be compared with the relish of a good piece of roast beef.

Humboldt wandered with his friend Bonpland further to the Cuchivano ravine on a path rendered unsafe by jaguars (American tigers). Flames are emitted from this ravine, and this led Humboldt to interesting observations on volcanic phenomena and on earthquakes. The inhabitants of the district also made curious communications and prophecies on the increase of earthquakes in this region and in the pro-

vince of New Andalusia, which were only too soon realized. On the 12th August, the wanderers, after much climbing, reached the chief station of the Chaymas mission, the cloister Caripe, where Humboldt passed some especially calm and beautiful nights, which he did not forget in later years. "Nothing," he says, "can be compared to the solemn repose which the contemplation of the starry heaven in this desert affords." When at the fall of night his eye rested on the meadow-plains bounding the horizon, he seemed to see the starry vault of heaven supported by the surface of the sea. The tree beneath whose shade he was resting, the luminous insects floating in the air, the bright southern constellations, all this forcibly reminded him of the distance from his home; and when, in the midst of this foreign nature, the cowbells or the bull's bellow was suddenly heard from the valley, then the memory of the fatherland rose brightly before him. Humboldt celebrated here a solemn reminiscence of home; these sounds seemed to him as distant voices from beyond the sea which transported him to the other hemisphere, and the inexhaustible spring of joy and of sorrow gushed forth in his imagination.

On beautiful mountain paths alternating with marshy, heavy roads, Humboldt and his companion visited the other stations of this mission, especially San Antonio, and Guanaguana; and he also visited the Guacharo cave, situated in the Caripe vale. This cave is the dwelling-place of a night-bird, frequently found here, which cannot bear the light of day, is three and a half feet in breadth across the wings; which utters an unpleasant scream, echoing along the vaulted cave; and which, strange to say, lives exclusively on grain. Humboldt was the first who brought intelligence of this cave to Europe, in which, according to the belief of the aborigines, the spirits of the departed dwell; and which, therefore, no one enters, from religious dread. When Humboldt and Bonpland had, with great perseverance, completed their drawings, and had packed

up the collected specimens, they commenced their retreat on the 22nd of September, over dangerous precipices, and through thick forests and ferns: on the way, they for the first time became acquainted with the monkeys inhabiting this region, who utter a melancholy and discordant cry. Humboldt remarked here, that the monkeys seem the more depressed and melancholy the nearer they resemble men; that with the increase of their apparent reasoning faculties, their impetuous sprightliness diminishes in equal proportions.

The travellers next arrived at the town of Cariaco, where the unhealthy local influences had produced a malignant fever; they therefore embarked speedily, to reach Cumana, a distance of twelve miles by sea; and during the voyage, Humboldt continued his studies of the tribes of the Indians he had hitherto met, and of their language. His second residence at Cumana was more eventful than the former one; for he narrowly escaped falling a victim to an attempt at assassination. The attack was made on the two naturalists by a Zambo—*i.e.*, a cross between a negro and an Indian, as they were, according to their wont, walking along the shores of the gulf, on the evening of the 27th of October, 1799. The Zambo did not hit Humboldt, who avoided the blow, with his heavy stick, but a second blow, which hit Bonpland on the temples, felled him to the ground. With Humboldt's assistance, he was, however, enabled to rise; and the two unarmed friends were preparing to meet the attack, which the Zambo continued with a large knife, when, fortunately, some Biscayan merchants came to their assistance, and the fugitive adversary was caught, and lodged in prison. Bonpland was the whole night in a feverish state, and his condition at first excited great anxiety, but the unfavourable symptoms gradually disappeared, and he recovered after several days.

But this accident did not deter Humboldt from the observation of the eclipse of the sun, which took place at this time, and his attention was soon directed to

new, highly important phenomena, whose advent had been predicted by the Indians at the volcanic Cuchivano ravine, from the superstitiously observed unusual natural appearances.

From the 10th October, his attention was directed to a reddish mist, which covered the sky for some minutes every evening; other remarkable air phenomena soon followed; the mist grew denser, the hot night air became un-odorous, the sea breezes failed to come, the sky was coloured like fire, and the earth's surface was bursting everywhere. Thus the 4th November arrived, and was an important day for Humboldt, because he was, for the first time, witness of an earthquake, and participator in its dangers. How new and how overpowering it was for him, and how soon he felt familiar with its dangers, is shown in these, his own words: "From our childhood upwards we represent to ourselves the water as a mutable, the earth as an immovable solid mass,—it is the result of daily experience. The appearance of a shock of earthquake, an agitation of the earth, of which we believed that it rested firmly on its old foundations, destroy the long-cherished illusion in a moment. It is a kind of awaking, but an unpleasant one; we feel that we have been deceived by the apparent repose of nature; henceforward we listen attentively to the least noise, and, for the first time, we distrust the soil on which we have so long confidingly wandered. But, when the shocks are repeated,—when they recur frequently for several days, then the uncertainty has vanished, we take new confidence, and become as familiar with the waving earth as the steersman with the wave-tossed ship." Not long since, when Humboldt was dwelling on these events of fifty years ago, he said that an earthquake has something universal, which one cannot evade; even the lizards living quietly at the bottom of the rivers, ran howling into the woods, and everywhere one stands on dangerous ground.

The inhabitants of Cumana were in great terror

when in the evening, at nine o'clock, a third shock was felt, accompanied by subterranean noises. Many persons hastened to Humboldt and Bonpland, to ask them if their instruments did not foretel fresh earthquakes. This afternoon must have been a grand one for Humboldt, if we think of the picture which he, with his talent for such natural scenes, has drawn of it. At an incalculable height it thunders uninterruptedly overhead, while the earth shakes; the people rush from their houses into the streets, uttering cries of terror. And this scene of the destructive powers of the labouring earth is followed by a splendid sunset on an indigo-blue sky, traversed by gold-fringed clouds and prismatic rays, while deep in the earth a threatening noise accompanies a new, violent shock.

Some nights afterwards Humboldt again had an opportunity of observing a considerable fall of shooting stars, similar to that on his journey from Europe. At that time already he presumed a regular recurrence of this phenomena, and we shall, in a later portion of this biography, show how, in consequence of Humboldt's communications, these meteoric appearances have been scientifically explained.

On the 18th November, Humboldt and his companion left Cumana on a coasting trip to Guayra, and with the intention of staying at Caracas until the termination of the rainy season. Their plan was then to explore the extensive plains of the Orinocco stream, to navigate the immense river south of the cataracts, up the Rio Negro to the boundaries of Brazil, and then to return to Cumana over Guyana, whose capital is called Angostura, or narrow pass. This was a journey of more than five hundred (German) miles, of which two-thirds would require to be made in boats. The country was, moreover, an unknown district, and no intercourse existed with the missions located there. Courage and perseverance, aroused by zeal for science, were their guides. Humboldt did not let the alarming descriptions of the colonists, who painted the threatening dangers and obstacles they would

meet from soil, animals, and savages, deter him from his plans.

Humboldt and Bonpland sailed quickly down the serpentine Manzanares, with its shores studded with cocoa-nut trees. They had embarked at Cumana on a small merchant vessel, and taken leave of that town as of a new-beloved home. Was it not the first land which Humboldt had trod, in a region on which his heart had been fixed from his earliest youth, and he says himself that the impression an Indian landscape produces is so great and powerful that after a residence of some months one seems to have lived there for years. This impression can in no way be compared to what a European northlander might perhaps feel after a short sojourn on the gulf of Naples, for the oaks and pines which grow on the Swedish mountains have a family resemblance to those of Italy and Greece—but here, between the tropics, where Humboldt wandered, nature appears quite new and magical, and in the open field, as well as in the close-grown wood, every reminiscence of Europe fades away.

The potency of these impressions makes up for their duration: this explains why Humboldt yet, at his advanced age, feels a kind of restless desire to see those spots, especially Cumana, again. There the sun does not only shed light on a landscape, as with us, —it gives a colouring to the different objects; it enfolds them, without destroying their transparency, with a light which makes the colouring more harmonious, and spreads a repose over nature whose reflex still exists in a high degree in Humboldt's mind. This explains Humboldt's grief at quitting Cumana, whose shores he had first trodden five months before as a newly discovered land, where he had, at first, approached every bush, every damp or shady spot, with a certain mistrust, and where he had now become so intimately acquainted with plants, rock, soil, and inhabitants. He did not conceal this parting pain, when in the evening he could no longer reco-

gnise the coast but by the occasional lights in the fishing huts.

Humboldt with his companion anchored in the harbour of New Barcelona, at the mouth of the crocodile-filled river, Rio Reveri, and he measured the altitude of the sea from a hill, in order to decide the geographical longitude of the place. The next day he set sail again, although his fellow travellers had determined to wend their way to Caracas over land, through a wild, marshy region, from fear of the unsteadiness of their little vessel on a stormy sea. Bonpland also went this way, to make a collection of new plants. Humboldt, however, with a pilot, boldly prosecuted the sea journey to Guayra, whose harbour is filled with sharks, and whose appearance is more that of a desert rocky island than of a continent. Humboldt only tarried here a few hours, especially as the yellow fever was raging, and reached Caracas on the evening of the 21st November, while the land travellers only arrived four days later, after having suffered much inconvenience and many hardships.

CHAPTER IV.

CARACAS—ASCENSION OF THE SILLA MOUNTAIN—EXCURSIONS INTO THE PLAINS TO SAN FERNANDO DE APURE—THE COW TREE—SAIL ON THE ORINOCCO—RIO NEGRO—RETURN ON THE CASSIQUIARE INTO THE ORINOCCO—ANGOSTURA.

HUMBOLDT remained two months in Caracas. This seat of the supreme court, under whose jurisdiction more than 30,000 people lived, seemed to him, at first, a solemn dismal town. He trod the soil as if he were haunted by a foreboding of the terrible visitation which awaited this town in 1812, when an earthquake buried 12,000 inhabitants under the ruins of their dwellings. The waning fogs descended from the mountains into the valleys, and, at first sight, Humboldt thought himself transported to the larch and pine covered Harz mountains. But he calls the vale of Caracas a paradise, a valley of eternal spring, where the temperature never, not even in the night, falls below 18 degrees; and where Pisang, citron, coffee-bushes, apple-trees, and figs, grow beside each other in rich profusion. The first melancholy impression of Caracas soon faded from his mind, when he perceived the beauty of the valleys, and especially when he experienced the agreeable impression which the inhabitants made upon his soul; for, however fertile nature may be, man is always its most important and most interesting feature. Here Humboldt found, instead of a noisy, varied life, a refreshing domestic life, which engenders frankness, cheerfulness, and refined manners. The inhabitants might, how

ever, be divided into classes; the firm conservators of the past, and the reform-loving renovators, inviting foreign influence to remodel the present, and build the future.

The most important scientific undertaking which Humboldt now had, was to ascend the Silla, a high mountain, whose summit none of the dwellers around had ever reached, wherefore, it was difficult to find guides. With the assistance of the governor, Humboldt obtained some negroes as guides. The excursion, which was joined, for the sake of the novelty, by about sixteen persons beside Humboldt and Bonpland, started on the 22nd January, 1800, on a day when, on account of the low clouds, they could calculate on pure clear air. The road, which the guides expected to make in about six hours, was a difficult one, but the trouble was richly rewarded by the surprising beauties of the scenery. It required as much courage as perseverance; several of the company lost courage on the way, and a young capucin friar, who was also professor of mathematics, and had shown much boldness at first, remained behind, on a plantation, halfway up, and watched the ascent of Humboldt and his more persevering companions, through a telescope. They found, at a height of 6,000 feet, Saranas (pasture grounds) covered with brambles and little yellow lily-like flowers; they hoped in vain to find a wild rose, not one of whose varied species Humboldt has found in South America, except the Montezuma rose, which grows on the mountains of Mexico in the 19th degree of latitude.

Arrived at the summit, Humboldt and his friend had a similar treat to that enjoyed seven months before on the peak of Teneriffe. The material pleasure of a surprisingly beautiful prospect into a new country, was joined to a mental activity of scientific research, and a better comprehension of the relation of the single part to the whole. From the summit of the mountain he gazed on a landscape where nature alone ruled without being influenced by men, or

their civilization. But he was already accustomed to find regions as large, perhaps, as France, being only an extended beautiful desert, and to see a world which belonged only to plants and animals, and where a human voice has never sounded in joy or in sorrow. Thus Humboldt stood at the brink of a precipice 8000 feet deep, which the evening mist was gradually veiling, and could not tear himself away from this spot, till prudence urged him to return. When their scientific investigations were completed, he descended with his companions, and reached a ravine at 10 o'clock that evening, where a dangerous path awaited them, more dangerous because the guides had secretly gone away to find a sleeping place in the rocks, and Humboldt and Bonpland were therefore obliged to carry their instruments themselves, oppressed as they were with thirst and fatigue. We have detailed this excursion to show the courageous perseverance of Humboldt's character, which does not swerve before dangers and difficulties, but is alone urged on by the love of science.

It was, therefore, only the peculiarities of an interesting region, and the anxiety to become acquainted with its form and natural products, which made him unmindful of the unusual distance, when he left Caracas in order to explore the large plains (llanos) of the Orinocco and Amazon streams, so rarely trodden by men. He did not select the shortest route thither, for he wished not to lose the impressions of the beautiful vales of Apogna; besides that his scientific zeal urged him to find the level of the more remarkable portions of the coast mountains by means of the barometer, and to navigate the Rio Apure, which flows through the immense plains to its junction with the Orinocco. The same motive led him to the mountains of Los Taquos, to the warm springs of Mariara, to the fertile shores of the sea of Valencia, and through the large prairies of Calabozo, in the eastern part of the province Varinas, to San Fernando de Apure on the similarly-named river, Rio Apure.

Humboldt's investigating mind found rich food for its inquiries on this excursion. What a common traveller would only have enjoyed with the senses, or overlooked as a solitary object, or admired *en passant* as a strange phenomenon, or collected it as a curiosity, that was for Humboldt the connected part of a great whole which his mental eye comprehended. The uncommon things he found here he was frequently able to explain from his European experiences; what in Europe had been unintelligible, he explained here in the tropical world from the similarity of common laws and causes. His geological studies found a rich material in the neighbourhood of the village of Antimano; his perseverance under privations was again proved by his having to spend the night in a sugar plantation on a skin on the ground, among noisy negroes, and yet he climbed the mountains again at sunrise. When he descended from the high mountain ridge westward into the valley of the little village San Pedro, and heard the Europeans, placed here for the superintendance of the cultivation of tobacco, utter complaints and imprecations on the accursed land in which they were forced to live, when he was quite inspired by the wild beauty of the place, its mild climate and fertile soil, he must have felt vividly that nature only reveals her charms to him who understands and appreciates her.

In the month of February, 1800, his path lay through the valleys of the Tuy, where he directed his attention to the sugar plantations of Manterola, to the gold vein, to the corn-fields (on which a twentyfold harvest is considered a moderate return), to the celebrated zamang-trees, with their gigantic branches, to the colonies in Hacienda de Cura, where he entered for several days into the mode of life of a wealthy inhabitant, taking two baths, three meals, and three sleeps in twenty-four hours; finally, to the cotton plantations near Cura, and to farming in general. Then he arrived at the sea of Valencia, where, among the productions of a foreign nature, he was reminded

of the sea-shores of the Canton of Vaud; for although nature in every zone, and under any circumstances, always bears a peculiar character, the mind willingly and fondly feels the similarity in the effect, without entering into analytical comparisons which are purely matter of science. Humboldt instituted interesting investigations into the causes of the decrease of water in this sea, which he found explained by the destruction of the forests, the cultivation of the soil in the plains, and the cultivation of indigo, as well as by the dryness of the atmosphere and the exhalations of the soil, and which induced him to institute further inquiries into the quantity of exhalation, which in turn became of importance to farming interests.

In the neighbourhood of Mariara, Humboldt found the tall Volador, whose winged fruit he and Bonpland collected and sent to Europe, and which grew in the gardens of Berlin, Paris, and Malmaison; he declares that the numerous specimens of the Volador growing in European conservatories all spring from the single tree of this kind which was found by him in the neighbourhood of Mariara.

The heat of the days obliged Humboldt to continue his excursion to New Valencia, commenced on the 21st February, by night only. After six days' journey on a beautiful road, endangered by jaguars, but rich in varied natural beauties, he reached this town, visited the neighbouring warm springs of Trinchera, and arrived at Porto Cabello, which he quitted again on the 1st March, and directed his steps to the first station on this journey, San Fernando de Apure, whence he went over Calabozo and the immense solitary plains of Caracas.

On his return from Porto-Cabello to the beautiful valleys of Araguay, Humboldt came to the farm of Barbula, where he saw the celebrated cow-tree, of whose remarkable qualities, as report had spread them, he had hitherto doubted. He found it to be a tree which, on incision, exudes a perfectly mild-tasting milk, which has an aromatic flavour, and is a

source of healthy nourishment to the negroes. We enumerate this tree, especially, in a biography of Humboldt, as he himself states that few of the numerous and remarkable objects he met with on his journey have made such a vivid impression on his mind, as this cow-tree, which resembles the star-tree in form. This impression is partly induced by our early associations; for everything relating to milk and corn excites a natural interest in man, which is not only based on a thirst for a knowledge of natural facts, but which arises from the idea and feeling that without milk, from the mother's breast upwards, and without flour, we could not have existed. To this may be ascribed the religious veneration for corn, and for milk-giving animals, with ancient and modern nations. As milk is generally considered only as an animal product, the idea of a milk-producing tree is the more startling, as one has always doubted its existence; and therefore Humboldt, whose soul was so susceptible to new general impressions, without therefore prejudicing his scientific analyzing powers, gazed with astonishment at the wonderful tree. He thus gives way to his impressions in its description: "Here are no splendid shadowy trees, no majestic streams, and no eternally snow-covered mountains, which mightily move us. A few drops of a vegetable sap remind us of the almightiness and fruitfulness of nature. On the sterile declivity of a rock there grows a tree whose leaves are dry and tough, whose thick, woody roots can hardly penetrate the stony soil; for several months of the year no refreshing rain moistens its foliage, the branches seem dead and shrivelled; but make an incision in the stem, and a sweet, nourishing milk flows from it. At sunrise, this vegetable spring is the richest; then the negroes and the natives come from all sides, provided with large vessels to collect the milk, which turns yellow, and thickens on the surface. Some empty their vessels, at once, under the tree, others take the milk to their children. One seems to see the establishment of a shepherd who distributes the milk of his herds."

Science, which searches after the cause of every phenomenon in its effects, certainly deprives it of its marvellous character, and perhaps also of a part of its charm, in the eyes of those who are only able to gaze, and not to examine. But in Humboldt, the first emotion of nature, and the penetrating, inquiring mind for the natural reasons and laws of every appearance, are united in a higher, harmonious character, and the first impression on his feelings is always succeeded by the clear insight of the naturalist.

Humboldt relinquished his formerly cherished intention of visiting the Eastern branches of the Cordilleras in New Granada, as he would no longer delay his journey to the Orinocco, for his chief purpose now was to explore the junction of that river with the Rio Negro and the Amazon. On the 6th March he left the valleys of Araguay, with his companion, to continue his wanderings in the steppes, whose peculiarity, in contradistinction to the African steppes, he has especially treated. He crossed the prairies, plains overgrown with gigantic grasses, in which many a jaguar lies concealed, and which no shade refreshes, as the palm tree growing here is parched, and almost leafless. Humboldt inquired here into the breeding of horses and horned cattle, of which large herds live on these desert spots, and whose export is an important trade for the seaports on the coast. Over Calabozo their way lay through the deserts of the llanos of Caracas, where Humboldt found a new subject for inquiry in the gymnotes,—the electric fish. The waters near Calabozo, which flow into the Orinocco, and the marshes, were filled with these electric eels, and Humboldt saw, at the same time, the peculiar manner of catching them by means of horses, some of whom were drowned. The eels attached themselves to the horse's belly, and stunned them by their electric shocks; so that a real fight on horseback had to be waged with these animals until they were exhausted, and had to collect new galvanic power, and those stunned horses, which had escaped drowning, had been restored.

On the 27th March, 1800, the travellers arrived in San Fernando de Apure, after having two days before, without any track, crossed the large plain of the Caracas steppes, where the eye sees no object even five inches high within the horizon, and where he unexpectedly found a small capucin establishment in the desert. The three days they spent at San Fernando were employed in cultivating a better acquaintance with this district, which is subject to frequent inundations, and therefore reminds one of Lower Egypt, and where the Orinocco and Amazon find their natural level by a peculiar aquatic system. The rainy season with its numerous storms, in whose train the inundations generally follow, was commencing, and although the atmospheric phenomena of this season were an interesting, absorbing subject of his inquiries, still the rain induced him to continue his journey on the river Apure itself, on a piroge or broad boat, as the Indians build it, and which was manned by a steersman and four Indians. Provided with provisions for a month, and with objects for barter with the Indians on the Orinocco, they embarked and sailed down the stream, which abounds in fishes, sea-cows, and tortoises, and on whose shores the birds often served them for food. Everything noteworthy which occurred to the observing Humboldt on this river journey he drew at once, and it was his wont always to note down whatever interested him on the spot, for what is written in sight of the objects one would describe bears the impress of truth, and this feature lends a charm even to the most insignificant things which Humboldt wrote. The greater and the more imposing nature reveals itself, the more simply true are his delineations, which is the most preferable feature of plans made on the spot.

It was Humboldt's intention to sail down the Apure and up the Orinocco, into which the former river flows, and then to continue his journey on the Rio Negro. The brother-in-law of the commander of Varinas, Don Nicolas Latto, accompanied him on his

journey, and his amiability and cheerfulness often made the travellers forget the hardships and danger of their position. And, indeed, for less courageous persons it would have been no agreeable journey, for tigers, tapirs, and pecaris, did not in the least avoid the passing boat; almost as in the original paradisaical state, panthers, hoccos (a black feathered animal), and crocodiles from 18 to 22 feet long, gazed at the travellers, and when they rode at night the tigers went into the woods for prey, the wild animals howled in the forests, the boat drove against trees which floated on the water, while sometimes the cry of the parrot was intermingled with more savage cries, and was merrily responded to by the little monkeys on the shore.

In this manner the ship's company rowed from the Apure into the wide expanse of the Orinocco, which, with its high, foamy waves, stretched before them like a sea. The beauty of this wild nature pleased Humboldt as much as the tradition of the Indians about this water. Humboldt had nearly sunk once with the ship during a high wind, in consequence of the steersman's carelessness, and the water already covered his papers and specimens; a mere accident saved him and his companions, and when they at nightfall bivouacked on a sterile island in the stream, eating their evening meal in the moonlight, seated on tortoise-shells, the form of danger again arose before Humboldt's soul. He had only been on the Orinocco three days, and a ship's journey of three months, connected with far greater dangers, was yet before him. Thinking of this hour, he writes:—"There are moments in life in which, without absolutely despairing, the future seems very uncertain; one is more apt then to indulge in solemn reflection when having escaped a danger, one has need of a great emotion."

And while he thought thus and lay on skins on the ground, the jaguars swam through the stream, and played round his resting-place.

The Orinocco here, although 194 miles from its

mouth, had already a breadth of four leagues, and when they were near the shores of Pararuma the steersman would not venture farther. Humboldt hired another ship from a missionary, and set sail on the morning of the 10th April. The reader may form an idea of the hardships to be endured, by a description of the Indian vessel which the travellers had now taken possession of. On the back part a kind of arbour had been made for four persons, but it was so low, on account of the wind, that they had to lie stretched on hard tree trunks, and to stretch the feet out beyond the roof, or to sit in a bent attitude to gain sufficient room. In front sat, two and two, the naked Indians, who accompanied the monotonous sound of the oars by equally monotonous and melancholy songs. Besides this, the ship was filled with the collected monkeys and birds, who, with the instruments, formed the centre around which the hammocks were slung, while around all this, fires had to be kept up to drive away the jaguars. The instruments had to share the couch of the travellers at night, and whenever they were required the travellers had to land and unpack. Add to this the oppressive heat, and the troublesome mosquitos, which the one tried to send away by a suspended handkerchief, and the other by smoke. Humboldt says, when he speaks of these days, that these hardships could only be made endurable by inborn cheerfulness, mutual good-will, and a lively sense for the splendours of nature.

A remarkable rising of the stream gave him the opportunity of investigating the levels of water. During the journey up the river the ship passed the mouth of several tributaries of the Orinocco, especially the Meta, which resembles the Danube in length, breadth, and bulk; it passed the town of Apures, where Humboldt visited the missions and the waterfalls, which made a deep and lasting impression on him. In his description of these regions he vividly reflects their physical nature; he describes a nature which perfectly harmonises with the requirements of his feelings,

for the character of a landscape stands always in a mysterious relation to the soul of man. Such an impression the great waterfalls of Atures and Maypures also made on him; he tarried among them five days, and then continued the journey to San Fernando de Atabapo, on the Cassiquiare, which unites the Orinocco and the Rio Negro in a peculiar manner. A new plan had to be made in the little town of Atabapo, in consequence of the advice of the prior of the mission stationed there. At his recommendation it was determined first to sail up the Atabapo, and then to follow the rivers Temi and Tuanimi. Humboldt here found himself suddenly in quite a new country, and on the shores of a river whose name he had never heard pronounced. He sailed straight into deserts where human beings scarcely left a trace of their existence. Indians who went out man-hunting lived in these deserts, and annoyed the missions situated near them. In this wild tract of America, Humboldt seemed to himself to be transported to those times when the earth was being gradually peopled, and to be witness of the first formation of human societies. The men he saw here had no other worship than that of the Spirit of Nature.

On the 6th May, Humboldt reached the Rio Negro, little river, famed for its various windings, after having been imprisoned for thirty-six days in the narrow fragile boat, where the getting up of one of the travellers from his seat would have been the cause of the overturn of the boat, if he had not given notice of his intention first to the rowers, that they might prevent the danger of overturning and drowning by balancing the other side of the boat. Although he had suffered much from insect bites, Humboldt had not been affected by the unhealthy climate, the dampness and surge; therefore, when he had arrived on the isthmus between the Orinocco and the Amazon, he looked back with pleasure on the dangers passed, feeling convinced that he had fulfilled his most important purpose, which was, astronomically to determine the course of

that arm of the Orinocco which flows into the Rio Negro, and thereby to verify its existence, which for half a century had been sometimes believed and sometimes doubted. The existing charts were so faulty, that Humboldt's presence in these regions became of the greatest scientific importance, in the accurate determination of localities, and the correction of errors in the charts.

What Humboldt felt at the sight of this equatorial region will be most faithfully given in his own words. "In these interior districts of America," he says, "one almost accustoms oneself to consider man as something unimportant in the order of nature. The earth is covered with plants, whose free growth is checked by no obstacle. An immeasurable layer of black earth testifies the uninterrupted action of organic forces. Crocodiles and boas are the lords of the streams; jaguars, pekaris, tapirs, and monkeys, fearlessly cross the woods in which they are settled as on an ancient inheritance. Such a scene of animated nature, in which man is as nothing, has something strange and depressing in it. It is difficult to accustom oneself to it on the ocean and in the sandy deserts of Africa, although there, where nothing exists which can remind us of our fields, woods, and rivers, the immense desert we traverse seems less strange. But here, in a fertile, evergreen, beautiful country, we seek in vain for traces of human existence, and seem to be transported into a totally different world. And these impressions are stronger the longer they endure."

Humboldt visited the Catholic missions which are dispersed over the country here, among them Maroa and the more southern Fort St. Carlos, the most southern Spanish military boundary guard, scarcely two degrees distant from the equator. Here Humboldt stood on neutral ground, from which he could have as quickly proceeded down the Amazon to the Brazilian coast, as he could attain the north coast of Carabas on the river Cassiquiare, down the Orinocco. He chose the latter as more suitable to his plans.

The ride on the river Cassiquiare was much incommoded by mosquitoes, whose numbers increased with the distance from the black water (Rio Negro); he only found miserable Christian settlements on the eastern and almost uninhabited western shore, and the natives he met consumed the indigenous ants with the same pleasure as the New Zealanders their spiders. But a still more dreadful immorality he found in the custom prevalent here of eating human beings; a few years before Humboldt's arrival, a native alkalde had eaten one of his wives, after he had first fattened her with the greatest care. The reproaches of the Europeans to these Indians on their abominable customs were entirely fruitless, and Humboldt says that it is with them, just as with us in civilized Europe, if a Brahmin from the Ganges were to reproach us for eating animal food. Indeed, Humboldt travelled here among Indian tribes who considered each other as totally different beings, and who believed themselves as justified in killing each other as the wild jaguars in the woods. Although Humboldt was already accustomed to the sight of a luxurious tropical nature, he nevertheless felt surprised as he sailed further on this broad, impetuous, incommodious river Cassiquiare, and made various vain attempts to land, because the shores were impenetrably overgrown with foliage and creeping plants. Though the travellers' hands were thickly swollen with insect bites, they had to take an axe to make the way to a resting-place, because the rain did not permit them to remain in the boat at night; and while on the sea one often complains of want of drinking water, here the travellers suffered from a want of firewood in the midst of the forests, as the sappy wood would not take fire.

Humboldt calls the passage of the Cassiquiare the most oppressive of the whole American journey.

At last, after many privations, which the scientific zeal to behold the celebrated bifurcation of the Orinocco easily overcame, Humboldt and his companions again reached the bed of the Orinocco stream on the

21st May, 1800, three miles below the station Esmeralda. This bifurcation of the mighty waters he calls magnificent, and his travelling hardships were no more thought of in front of the granite rocks, 7800 feet high, where the two rivers separate. Such an imposing sight rewarded their perseverance, and especially enriched science; for here Humboldt collected the great materials and instructive explanations of a comparative hydrography, and the history of his discoveries in general enriched the history of geography with many important contributions. Here in this district he explained the physical relations of the soil, collected the similar phenomena of the old, and this centre American soil, and gave science an important insight into the analogy of natural formations, and the ruling laws of the globe in reference to its veins of water.

In the missionary station of Esmeralda, Humboldt became acquainted with the notorious poison called "curare," which is prepared here, and used in war, on the chase, and, strangely enough, as an internal remedy for abdominal complaints, and which, with the Ticunas poison of the Amazon stream, and the Upas poison of Java, is the most deadly of known poisons. The Indians prepare this poison from the fruit of the similarly-named plant, which they collect with certain solemn festivities, as the vine harvest with us, and from which one man, called the "poison-man," prepares the murderous matter. This matter was a new interesting subject for experiments for Humboldt, from which it resulted that the poison directly mixed with the blood by means of a wound, kills, while, taken inwardly, it is an excellent tonic The preparer of the poison incautiously and unknowingly rubbed a little of the stuff in Humboldt's presence with his wounded finger, and fell stunned to the ground; but his life was saved by rubbing him with muriate of soda. Humboldt had also nearly fallen a victim to this poison, as it had run into his linen out of a badly-secured bottle, and he fortunately perceived some of

the poison in a stocking as he was putting it on, which, as his toes were sorely bitten by insects, would infallibly have killed him.

When Bonpland had prepared some arrows with this poison for the purpose of shooting birds, and had been with Humboldt witness of the very remarkable Curare feast, which is accompanied by dancing and drunkenness, the two naturalists continued their journey. Humboldt had proved the connexion of the Orinocco with the Amazon, and, with this scientific trophy, gained partly by his journey to the cataracts, partly by inquiries made of the soldiers of San Carlos who had made an expedition in search of the sources of the Orinocco, he bid adieu to a district which had been unknown before his time, and which had only been a land of fables for former writers of travels. The discovery of the sources of this great river was left to a future naturalist, the traveller Schomburgk, who visited these districts in the interest of the Geographical Society of London.

From the missionary establishment of Esmeralda, Humboldt and Bonpland travelled further on the 23rd May, 1800, sailing down the Orinocco, and, without being properly ill, they were nevertheless, in consequence of the hardships they had gone through, of bad food and insect torments, in a thoroughly exhausted and weak condition. They found little to cheer them along the river, as they met no living beings, only interminable plains, and sometimes high mountains; they experienced a feeling of abandonment the more deeply as inscriptions on the rocks and rude sculptures in granite showed traces of a former existence of civilized beings, and were evident monuments of the decayed civilization of a nation formerly existing here, but now annilfilated. Although exhausted and depressed, they neglected not a single interesting natural specimen, and thus they reached the passage over the great waterfalls of Maypura, which occupied them two days. On the 31st May, they landed on the eastern shore of the stream near Puerto de la Expedicion, to

see the cave of Ataruipe, the probable cemetery of an entirely obsolete nation, and where in a short time they counted 600 well preserved human skeletons, regularly ranged in baskets of palm leaf branches. Humboldt examined the graves and their peculiarities, and took several skeletons and skulls away, which the corpse-fearing natives transported with great repugnance. In a quiet starlight night he left this spot of a passed-away nation—of an extinct Indian tribe.

Unfortunately these skeletons did not reach Europe, for, as we shall show in a subsequent portion of the volume, the first consignment of collections, about a third of the entire American trophies, was lost by shipwreck.

For the second time Humboldt and his friend ventured to navigate the waterfalls of Atures in his light boat, the varied scenery which the long succession of waterfalls afforded made the trip as beautiful as dangerous. Their falling in with the Otomaks living at Uruana showed Humboldt a new phase of human existence, as it is remarkable that men should find a pleasure in eating lime, or dirty clay soil, while they live in the most beautiful and fertile districts, and that they produce intoxication and madness by means of the niopo powder, prepared from the husks of a mimosa plant, when they ought not to be visited by the degeneracy of civilized snuff-taking human beings.

After a passage of seventy-five days, during which the travellers had sailed 375 geographic miles on the five great rivers—Apure, Orinocco, Atabapo, Rio Negro and Cassiquiare—in a small boat under a burning sun, exposed to constant dangers and insect torments, they arrived at Angostura, the chief town of the province of Gugana, in the middle of June, 1800. The hardships they had undergone were soon obliterated from their memory when they were welcomed by a kind reception from the governor of the province, but their over-taxed physical strength was now too much ex-

hausted to resist a nervous fever attack. For more than a month Humboldt was detained at Angostura by his illness, and Bonpland's condition was so serious that he only retained strength sufficient to treat his own malady, and gradually to bring about his recovery.

But now new plans roused Humboldt and his friend to fresh travelling expeditions.

CHAPTER V.

JOURNEY TO HAVANNAH—CHANGE OF PLANS IN CONSEQUENCE OF A FALSE NEWSPAPER REPORT CONCERNING BAUDIN'S EXPEDITION—CARTHAGENA—SAIL ON THE MAGDALEN STREAM—LABORIOUS JOURNEY TO QUITO—CHIMBORAZO—THE RIVER AMAZON—HUMBOLDT'S CURRENT (PERUVIAN COAST CURRENT)—MEXICO—RETURN TO EUROPE.

THE travellers had determined in Angostura to return to Cumana or New Barcelona, and from one of these ports to go by sea to the island of Cuba and thence to Mexico, there to devote a year to a physical scientific investigation of New Spain. After that it was intended to visit the scarcely-known Philippine islands, and to return to Europe by way of Bassora and Aleppo. The way from Angostura to the northern coast, through the immense steppes, was a most arduous one, and the botanical and zoological specimens, which they could not venture to leave behind, detained them so long that thirteen days were spent in packing them up. When at last they were ready to start, it took them a considerable time to pass through the Karaibes, whom they met with at Cari, a missionary establishment in the plain, and who particularly excited Humboldt's interest. They arrived safely at New Barcelona on the 23rd July, though exhausted by the sand winds of the plain. They lived with the same good-natured man who had so hospitably received them seven months before, when they first came to Barcelona. A typhus fever threat-

ened Humboldt here as it had done in Angostura, but Bonpland regained full strength and activity during the four weeks Humboldt was ill.

Their first care now was to forward the treasures they had collected to Europe, so that they might, unencumbered, prosecute their search for more trophies. A young missionary who, seven months before, had at his first acquaintance with Humboldt shown a lively interest in his expedition, volunteered to accompany the travellers to Cuba, and there to set sail with the rich collection, and a boy, who was confided to his care for education in Spain.

Humboldt accepted the welcome proposal, as he thought he could not send his collections and a portion of his manuscripts home by a safer opportunity. How painfully it must have moved him on his subsequent return to Europe to hear that the whole consignment of his collections, as well as the young missionary and the boy, had been entirely lost at sea.

Humboldt waited in vain for a packet-boat, such as usually sail between Corunna, Havannah, and Mexico. As none had arrived for three months, it was feared that English cruisers must have seized them, and Humboldt and his companions wished to reach Cumana as quickly as possible. They therefore embarked on an open vessel laden with cocoa, whose owner thought that as he served the smuggling trade with Trinidad he need not fear the English vessels. But it was soon brought up by a privateer. Humboldt and his companions had to go on board, and while they were yet treating in the interest of their own captain, an English war-sloop came up and liberated the boat. The captain of the sloop received Humboldt in a very friendly manner, and he felt agreeably excited, after a long sojourn among savages, to see and speak with Europeans again. In Cumana, also, Humboldt and Bonpland were the more affectionately welcomed by their friends, as the report had been spread here that the bold travellers had been killed some months before, on the Orinocco. But

the severe English blockade detained them two months and a half in Cumana, during which time Humboldt was occupied with botanical, astronomical, and meteorological inquiries, and with geological investigation of the peninsula of Araya. At last, on the 16th of November, 1800, he left Cumana for New Barcelona, to start from there with an American vessel; and he says himself that he could not gaze for the last time on the tops of the cocoa palms on the shores of the Manzanares, faintly illuminated by the moon, without deep emotion.

The ship raised anchor on the 24th of November, and, spite of the late season, reached Havannah on the 19th of December. Humboldt shortened the long, unpleasant voyage by observations of the sea and sky. Their collections had been sent to Europe, and Humboldt and Bonpland did not imagine that they would never see a portion of them again. Their stay in Cuba lasted several months, during which Humboldt was principally occupied with examining the extent, soil, climate, culture, and population of this queen of the Antilles, as well as with the condition of the slaves, historically and morally considered, and with agriculture.

On the point of going to Vera Cruz to complete their above named gigantic expedition over Mexico, Acapulco, the Philippine Islands, and thence home over Bombay, Bassora, Aleppo, and Constantinople, Humboldt perceived from newspaper accounts that Captain Baudin, whom he had promised by letter before his departure from Corunna that he would join him from any place he might be if he heard that his delayed expedition was realised, had really left France for Buenos Ayres, with the intention of rounding the Cape, and then coasting along Chili and Peru. As Humboldt had declared his purpose of joining the captain publicly, before the Museum in Paris, the desire to search for him became urgent, especially as he anticipated more important and more extensive results from his journey if he could prosecute his inquiries in conjunction with the French *savans* who

he knew would have followed Baudin. Although many intelligent persons in Cuba opposed this plan, and referred particularly to the uncertainty and deception of newspaper accounts, they had no influence over Humboldt, who, impressed with the idea of his promise, and inspired by the hope of exploring the physically so remarkable and rich Spanish possessions, for fifty years inaccessible to every stranger, remained faithful to his purpose. He had, from the first, made it the chief aim of his voyage to complete the most important hitherto neglected investigations of the earth and its nature, and to bring about a really scientific natural philosophy of our globe.

With this truly inquiring mind for science, he hired a bark on the quay of Batabano, with which he proposed to go to Porto Cabello, or Carthagena, with a favourable wind. With this hope he went with Bonpland to Batabano on the 6th March, 1801, arrived on the 8th March, at what was at that time only a miserable marshy village, and steered thence south along the island of Cuba, but at the same time examined several points of the coast and the neighbouring islands, and determined astronomically their geographic position. He had calculated that this voyage would only occupy about a fortnight, but it lasted nearly four weeks, as contrary winds detained them, and the ship, driven too far west by the storm, had to land at the Rio Sinu, on the continent of South America. Here no botanist had ever examined the vegetable kingdom, and Humboldt and Bonpland found an acceptable task until the 27th March, when the ship started again. Its owner, however, did not accede to Humboldt's request to land in Columbia, on account of the wild region in which they were. The savage state had been shown on their first landing; for when Humboldt and Bonpland rowed to the river shore with the intention of botanising in the moonlight, they would have fallen into an ambuscade of naked men, armed and laden with chains, being probably criminals broken loose, if they had not retreated in time and with caution to the ship.

The next morning brought Humboldt to the port of Carthagena, where for six days he was employed in astronomically determining localities, and where he witnessed the popular Easter festivities, which were accompanied by strange exhibitions. At the same time his plans met with their first check here, for he heard, to his infinite regret, that the season was much too far advanced now to undertake a voyage on the South Sea from Panama to Guayaquil, and he was therefore compelled to relinquish his intention of exploring the isthmus of Panama.

Near Carthagena lies an Indian village, called Turbaco, whose fertile woody environs greatly enchained Humboldt's attention, more particularly the remarkable wind or air volcanos, called volcanitoes,* lying in the midst of palm-groves. A hitherto unknown world of plants, also, was spread before him and Bonpland, who indeed occupied himself principally with botany.

Humboldt endeavoured, by other studies, to compensate for the journey, postponed on account of the lateness of the season; and the treasures of science he had collected on the Orinocco stream encouraged him to undertake a similar trip on the Magdalen stream, a river flowing through the beautiful and majestic valleys of New Granada, and entering the sea by several mouths not far from Carthagena. They took a boat, and went up the stream into the country as far as Honda, where Bonpland explored the rich botanical treasures of the shore, while Humboldt drew a chart of the river district, in spite of the torments of insects, climate, and dangerous localities. At Honda they landed, to proceed to the capital, St. fe de Bogota, on mules, almost the only travelling convenience on the continent of South America. They had

* These volcanitoes consist of fifteen to twenty blunted cones, nineteen to twenty-five feet high, situated on a large free spot of about 1000 square feet in the centre of the wood. They have an opening filled with water, and emit air bubbles, accompanied by a loud noise.

been travelling on the river and in the valleys for thirty-five days, and remained in Bogota till September, occupying themselves with botanical and geographical researches, and admiring and studying the magnificent natural formations of the rocks and waterfalls of Tequendama, the mines, and the picturesque remains of former earthquakes. On a dangerous path over the inconvenient pass of the Andes of Quindiu, whose highest point is 11,500 English feet above the sea, they proceeded to Popayan; in the rain, quite wet through, and barefoot on the soft soil, sleeping under the free heaven at night, and awaking exhausted in the morning, they passed through the Canca valley, visited the snow-covered volcanoes, Purace and Sotara, through Pasto, a little town situated at the foot of a burning volcano, crossed the equator, and arrived at Quito on the 6th January, 1802, after a journey of four months.

Here Humboldt soon recovered from the effects of the dangers and privations of the journey, in the highly agreeable and equable climate of this country, and he employed his stay of nearly nine months, in geological and botanical studies; his sense for natural beauty and cheerful landscapes finding abundant food for gratification in the enchanting situation of the place, opposite long ranges of gigantic snowy mountains. He ascended the crater of the volcano Pichincha, though not without trouble, and several unsuccessful trials. On it, he made experiments on the electric, magnetic, and hydraulic properties of air, measured altitudes, and, indeed, studied the chain of the Andes, in a geognostic point of view, so fundamentally that his works became the most important materials for the foundation and prosecution of the study of modern geognosy. He wandered to the majestic snowy tops of the Antisana, and of the Cotopaxi, the highest volcano of the Andes, whose thunders are often heard at a distance of 200 English miles, at Honda, on the river Magdalen; he ascended Tunguragua with Bonpland and a young enthusiast

for science, named Montufor,* who accompanied him on this journey, and on the 23rd June, 1802, he even ascended the Chimborazo, where he climbed to a height of 3036 toises, an elevation to which no man before Humboldt had ascended. Nature seems, indeed, most unwillingly to allow mortals to penetrate into her mysterious depths, or ascend her mysterious altitudes; above she threatens them with the fatal consequences of a rarified unbreathable atmosphere, below with suffocation in a hot condensation of air. On the point of Chimborazo which Humboldt reached, the blood flowed from his eyes, his lips, and his gums, breathing became difficult, and the thermometer stood still.†

Arrived at Quito, Humboldt received a letter, which communicated to him that Captain Baudin had sailed to New Zealand, and turned eastward, round the Cape of Good Hope. The plan of a junction with Baudin, and the, in that case, practicable journey to Mexico and the Philippine Islands, which he had cherished for thirteen months, was now suddenly frustrated. But he was already accustomed, from former times, to such disappointments of long cherished projects, that he did not lose courage, but, depending on his own resources, resolved not to lose sight of his purpose. He determined to sail from Quito to the Amazon stream, and to arrive in Lima, in time to enable him to observe the passage of the planet Mercury across the sun's disk.

Under indescribable difficulties, Humboldt and his faithful companion Bonpland reached Loxa, on a path leading through the snowfields of Assuay and Cuenca, which made the transport of the scientific instruments, and the extensive collection, more troublesome. In the woods here, they examined the various species of the China-tree, then wandered eastward over the

* Don Carlos Montufor fell a victim to political partisanship in 1811.

† On the 16th December, 1833, Boussingault, the only one who has since ascended this mountain, reached, not the summit, but a point 400 feet higher than Humboldt could venture on.

Ganges, surveyed the splendid remains of the old Peruvian viaduct of Inka, which leads from Cuzco to Assuay, and then arrived at the Amazon. Here, in the province Jaen de Bracamoros, Humboldt corrected and revised the chart of the Amazon made by the French astronomer, Condomime, by sketching a most accurate chart of this unknown portion of the great stream, partly from his own observations on an excursion to the cataracts of Retama, partly from careful inquiries; Bonpland, in the mean time, continuing his botanical investigations.

Crossing the high chain of the Andes for the fifth time, Humboldt now returned to Peru, ascertained the position of the magnetic equator, visited the productive highly situated silver mines of Hualguayok, where the silver is found 2000 feet above the level of the sea, the hot springs of Caxamarca, and the ruins of the ancient town of Manfiche, with its old pyramids, in one of which, in the 18th century, more than four millions French livres of pure gold were accidentally found. Returning to Truxillo, over the western Cordilleras of the Andes, Humboldt, at his descent, enjoyed the sight of the Pacific Ocean, for the first time; and, at the same time, looked down into the long narrow valley which is celebrated because it never rains or thunders there. Crossing the sterile shores of the Pacific Ocean towards the south of Truxillo, the travellers arrived at Lima, the chief town of Peru, where they remained for some months, and instituted important climatic and astronomic inquiries here and in the neighbouring port of Callao, and arrived in time to observe the last period of Mercury's passage, before entering the sun's disk; for which purpose, even heaven was propitious, as, in Lima, on account of the thick fogs, the sun is often not seen for three weeks. We must especially mention Humboldt's investigation of the remarkably cold Peruvian coast current, for, subsequently, science has given to it the name of Humboldt current, in appreciation of the merits of the great natural philosopher.

In the January of 1803, Humboldt and Bonpland sailed for Guayaquil, in a royal corvette. But on the 6th January, a noise and roaring filled the air, and they heard that it was the sound of the volcano Cotopaxi, which was now in labour, and which Humboldt had ascended the year before. The wish to observe the volcanic eruptions and ravages of this mountain as nearly as possible, made Humboldt soon ready to set out to visit the volcano once again. But on the way thither, he and Bonpland were obliged quickly to return, as the news reached them that the frigate Atalante, in which they wished to sail, was obliged to start.

After a journey of thirty days, they arrived in Acapulco, a western port of New Spain, whose scenery is as picturesque as its climate is hot and unhealthy. At first, when his plans had necessarily to be changed, Humboldt intended only to remain a few months in Mexico, and then to return to Europe, because his instruments seemed to him to have suffered, and his endeavours to remedy their imperfections were in vain. But the country, and the inhabitants of Mexico delighted him so, that he did not like to terminate his journey as speedily as he had originally proposed. The scientific and genial charms of a country so rich and diversified in its scenery, were too strong to be overcome. But this journey needed also the greatest precaution, as the yellow fever, which is indigenous there, and infallibly attacks and kills all those who descend into Mexico from the highlands, from July to October, induced Humboldt to remain at Acapulco till the end of the winter, and then to commence his journey into the interior. During that period, he was actively employed in experimenting on the atmospheric phenomena, and with the arrangement of his manuscripts and specimens.

But in the middle of winter they started, and descended first into the glowing hot vales of Paraguay, where the temperature, in the shade, was at 32 degrees Reaumür. He found a milder and fresher

climate on the plains of Chilpantzingo and Tasco, lying about 6000 or 7000 toises* above the level of the sea, and whose rich silver mines he visited; thence their journey lay over Cuernaraca, and through the fog exhalations of Cuchilaque to the beautiful town of Mexico.

As the longitude of this place had, down to that time, been incorrect on the common maps, Humboldt rectified it by accurate astronomic calculations. But the antiquities especially occupied him here, and the statistics of the population. Having borrowed instruments for the purpose of the astronomic measurements above-named, from the excellent mining academy of Mexico, whose director was also a pupil of Werner, in Freiburg, he extended his inquiries to the celebrated mines of Moran and Real del Monte, and their environs, whence he returned in July, 1803, to proceed to the northern districts of the country. He surveyed the artificial breach in the mountain Sinog, near Desague de Huehuctoca, which had cost six millions of piasters, and was intended to conduct the waters from the valley of Mexico; he then repaired, by way of Salamanca, to the celebrated mining town Guanaxuato, where he devoted two months to geognostic studies, especially to the detection of ores, and then travelled through the valley of San Tago, southwards to Valladolid, the capital of the ancient kingdom of Mechocan. The rainy season did not deter the bold, and in the interest of science, indefatigable man from descending with his friend to the coasts of the Pacific, into the plains of the Jorullo, where, in the plain Malpais, in 1759, a considerable volcano had sprung up in one night, whose 2000 craters were still smoking, and were examined at considerable risk by Bonpland and Humboldt, who descended 250 feet into the burning crater of the central volcanic cone, on fragile lava pieces. To these investigations, science owes a new important increase of its facts and revelations on the history of the

* One toise is equal to six feet.

formation of the world in general, and of this remarkable phenomenon in particular.

Humboldt and Bonpland returned once more to Mexico, over the high levels of Toluca, in order to arrange their botanic and geologic collections, to regulate and calculate the barometric and trigonometric measurements, and to prepare the sketches for a geognostic atlas.

In January, 1804, Humboldt set out on a more extensive excursion, to examine the eastern side of the Cordilleras, of Mexico; the altitudes of the volcanoes Popocatepetl and Tztaccihuatl, were trigonometrically measured, as well as the pyramid of Cholula, which was once built of bricks, by the Tulteks, and which was ascended on account of the beautiful view it affords on the snow-covered tops of the mountains, and the smiling valleys of Tlascala. After these investigations, Humboldt proceeded to Xalapa, over Perote, and had to pass through almost impenetrable forests of oak and fir trees, through which a road was subsequently made according to his plans, in consequence of his three times repeated barometric measurements of the locality. Cofre, a mountain, situated near Perote, and 162 toises higher than the peak of Teneriffe, was also ascended and measured, and also the peak of Orizava, past which his way led him. After a stay in these regions, which had proved most fertile in scientific studies and their results, Humboldt and Bonpland returned to Vera Cruz, on the bay of Mexico, fortunately escaped the yellow fever, raging in this sterile and waterless plain, and set sail for Havanna, on a Spanish frigate, to take possession of the collections left there in the year 1800. They tarried here two months, and then embarked on a ship which was to transport them to the United States of North America. After a violent storm, which lasted seven days, in the Bahama channel, they reached Philadelphia in thirty-two days, visited Washington from thence, and after the lapse of about two months, spent in the free states of North America, and where

Humboldt especially devoted himself to the study of the political relations and condition of the population, they returned to their native Europe, from which they had been absent more than five years.

In August, 1804, Humboldt and his friend Bonpland landed in the harbour of Bordeaux.

The journey of which we have here given an outline could not fail to create a great sensation in Europe. It was not only unexampled as the execution of the most magnificent undertaking of a German citizen; it was not only perfectly disinterested, and a sacrifice made solely to the interests of science; people admired not alone the courageous determination, the persevering force, the industry, the intellectual capacities, and inquiring talent of Humboldt's personality, but the gradually revealed unbounded results of this journey to the equinoctial regions of the new continent became of such universal importance in all branches of human science and commerce, in its influence on a new system of science even, nay, also on the political improvements of the country traversed, that Humboldt was hailed in Europe as the *second Columbus*. A hitherto entirely unknown or misunderstood region of the earth was placed in splendid landscapes before the senses of intellectual Europe, and not only was the exterior surface and its phenomena described, but science was made acquainted with the inner formation of the land, with its riches and its wants, with the secrets of its heights and its depths, with the circumstances of its animate and inanimate life, and from the chain of comparative facts was developed the discovery and comprehension of the great eternal world, and life-laws of the earth and its inhabitants.

And Humboldt was the best intellectual organ of these new revelations of science, for universality and power of combination were united in him; he had the talent for harmonious, calm, and reflective observation of nature, and a happily developed sense for truth and beauty of form; in him a creative and regulating

spirit, a deep humane mind, and reason, and a heart animated by the purest love for science and life were combined, and what he felt he was able to express truthfully and gracefully.

But he was specially favoured by Providence from his cradle upwards. Unlike thousands, perhaps the majority, of learned men, he had not to struggle against poverty and want; he had not to rescue his budding spirit from the despair and privations consequent on the want of the necessaries of life; he had not to rouse himself from the flagging of the wearied body; he came into the world as a privileged being; he was cradled among the highest social circles; his youthful education led him through the widely opened house and domains of science, through favour and wealth.

But it is his high merit that with these worldly favourable circumstances he did not give way to the charms and the indulgences of his aristocratic position, that he did not fall into the egotism of high birth, nor the pride of idleness, but that he, on the contrary, surrounded by the charms of a favoured position in life, still followed the inborn impulses of his spirit, that he made himself the self-sacrificing servant of science. It forms his morally high position as a man that he voluntarily and unostentatiously rejected the aristocratic comfort of a nobleman, that he joyfully sacrificed his property, and bore the greatest dangers and privations in the service of intellect, in his endeavours after knowledge, and a scientific extension of a comprehension of the world.

CHAPTER VI.

RETURN AND NEW ACTIVITY AT HOME—ASCENSION OF MOUNT VESUVIUS IN 1805—BERLIN—VIEWS OF NATURE—THE GREAT LITERARY WORK ON HIS TRAVELS IN AMERICA—DECLINING OF A PRUSSIAN OFFICIAL POST—NEW PLANS—DESTRUCTION OF CARACCAS—BONPLAND'S FATE—HUMBOLDT'S STUDIES IN PARIS.

WHEN Alexander von Humboldt started on his great journey, his brother William lived in Paris with his family, and we have already stated that Alexander's letters from Spain had induced his brother to visit this country. But during Alexander's absence much had been changed in his brother's position, for William had been appointed Prussian chamberlain and privy-councillor of legation, and resident minister at the Papal court in 1802, and therefore resided at Rome. His wife, whose health had become very delicate, had gone to Weimar on a visit, in 1804, and went thence to Paris, as she still hoped for the return of her brother-in-law Alexander, in spite of unfavourable reports. On the 28th March in this year, a letter from Havanna had been received in Rome by William von Humboldt, in which Alexander announced his speedy return to Europe. But very soon after, a report had been spread that he had fallen a victim to the yellow fever shortly before his debarkation, and this report, though unconfirmed, spread grief and great excitement in his brother's family in Rome.

But what must have been the delight and surprise of the suffering Madame von Humboldt when, during

her stay in Paris in August 1804, the sudden news arrived that the great traveller, already mourned as lost with but faint doubts of the truth of the report, had arrived in the Garonne with all his American treasures. The despatch which brought the intelligence from Bordeaux to the National Institute of Paris was immediately forwarded by the secretary to Madame von Humboldt, and as great as her surprise, was Alexander's astonishment when he, hastening from Bordeaux to Paris, found his sister-in-law there, while he had anticipated not being able to see his brother and his family in Rome till the commencement of the following year. As he had the intention of settling in Paris, for no town presented so many scientific and personal advantages as it, and he also only thought at first of arranging his collections, of completing his manuscripts to make them the foundation of a comprehensive literary travelling history, it was most agreeable for him that his brother's wife, who was expecting her confinement in the autumn of 1804, was remaining in Paris till the commencement of the following year. Then she proposed returning to her husband, who was in the meantime spending a happy solitude in Albano, commencing and completing the long planned translation of the Agamemnon of Æschylus, and inviting in September his friend Wolff, the editor of Homer, to share his charming solitude at Albano, and enjoy with him the beauties of nature in intellectual intercourse.

In Paris, Alexander von Humboldt really lived only in the recollection of his great journey, as he worked daily with Bonpland, the faithful companion of his joys and dangers, at the regulation of his collection, and he maintained a lively intercourse with the most eminent scholars of the capital on the success of his journey. Many of these eminent men, such as Cuvier, Gay-Lussac, Arago, Vauquelin, Oltmann, Laplace, and others, were actively engaged in the literary arrangement of his stupendous materials. Nearly a year elapsed before Humboldt found

time or was able to tear himself from the preparatory labours for his work. In the spring of 1805, the longing for his elder brother led him to Rome, where he paid a lengthened visit to his brother's family. William von Humboldt lived in Albano in a brilliant circle of wealth, and of intimacy with the most distinguished men at that time living in Rome, and Alexander's arrival increased the brilliancy and charm of the intellectual and genial circle. The joy of meeting between the two brothers so tenderly united in love, and so akin in their spiritual life from their earliest youth, was rich in exalted feelings and happy impressions. While William had expected the return of his brother with anxiety and longing, Alexander brought back into his brother's house that centre of intellectual life in classic antiquity, beside the dangers overcome, beside love and affectionate excitement, the grandest views of a newly discovered world in the freshest tints of their impressions. How vivid must have been the exchange of their thoughts and emotions, how must not Alexander, as the discoverer of a new scientific and real world, have been the radiating centre round which all who belonged to the intellectual circle of Humboldt's house eagerly crowded.

With what astonishment must they have listened to his communications, for which nature had endowed him with a glowing eloquence, when he gave them the images of new scenes, new natural and human life from the rich treasure of his new experiences. William von Humboldt especially was most inspired, as he was, more than all others, able justly to comprehend his brother's new views, to follow him in the new regions of science, and to raise his own European self-consciousness, his classical studies, and his political views to a higher, more universal standard through Alexander's descriptions.

But Alexander had brought special treasures for his intellectually congenial brother from the new world. We have before hinted that William von

Humboldt pursued philological studies in addition to the study of Greek and Roman antiquity; these studies acquired new impetus in consequence of Alexander's return, for in distant regions he had not neglected to cull spiritual food for his brother, and had, not without great exertions, discovered and collected a considerable number of hitherto unknown grammars of American dialects in the missions and cloisters he had visited on his dangerous wanderings. These he brought home to his delighted brother, and only made the condition, before presenting them totally into the hands of William, that he would occasionally, during the following few years, lend these philological treasures to Professor Vater, of Königsberg, and to Friedrich Schlegel.

If we consider the persons who at this period formed Humboldt's circle, or who were brought into temporary relation to it, we must confess that Alexander found a rich source of intellectual and genial pleasures in Rome. Beside several princes and statesmen, we need only name Madame de Staël and A. W. Schlegel, who lived so near to Humboldt's that they formed but one house; besides Schinkel, Count Moltke, Tiedge, and Frau von Recke, the brothers Riepenhausen, Rumohte, Rehfues, Sismondi, &c.

Alexander von Humboldt was called away from Albano in the summer of 1805 by his studies; Mount Vesuvius betokened an approaching great activity, and an eruption was probable. Humboldt joined his two friends, Leopold von Buch and Gay-Lussac, who had come to Italy to observe the mountain, and was at Mount Vesuvius on the 12th August, when a remarkable eruption took place. With the experience and views of the volcanic phenomena of the earth which Humboldt had gained on his journey, this ascent of Vesuvius in company with eminent natural philosophers became an instructive source of scientific knowledge, and while he instituted a course of magnetic experiments with

Gay-Lussac, he added new experiences and combinations to the observations of the magnetic needle which he had made in Paris in 1798, and examined especially the magnetic qualities of certain species of rock, especially of serpentin, a black-green, snake-like, spotted talc.

When Alexander had combined the happy moments of this fraternal meeting with new scientific inquiries, he returned from Italy, and tarried in Berlin during 1806 and 1807, where he had unfortunately to witness the political degradation of his native land, but at the same time achieved great scientific victories. It was especially the magnet which occupied him, and by the numerous experiments which he made on one and the same magnet during his travels, at that time, as well as at subsequent periods, he not only induced other naturalists to similar measurements, but furnished the elements which Biot worked on in calculating the magnetic equator. Humboldt had continued his magnetic observations with Gay-Lussac, with whom he was in the most intimate, friendly, and scientific intercourse, in Paris, and he had discovered that the great mountain chains, and even the active volcanos, exercise no perceptible force on the magnetic power, but that it deviates gradually with its distance from the equator.

But in a literary point of view Humboldt was also active, for he must have completed, or, at all events, commenced here in Berlin, the manuscript of one of the few works he published in German, as it appeared during the next year, 1808, when he was in Paris. At this period Humboldt had returned to Paris to his faithful travelling companion, Bonpland, in order to continue the gigantic work of travel they had commenced with the assistance of celebrated scholars.

The "Views of Nature," written in flowing German, under the impressions of vivid recollections, and celebrated for their thoughtful conception and rich revelations of terrestrial life in which he describes

the tropical countries, steppes, and mountain scenery he has traversed, in a masterly manner, and gives a physiognomy of plants, a description of the formation and effects of Indian volcanos, &c., was literally a gift of love to his brother William, and was publicly dedicated to him.

William von Humboldt, who remained in Rome as ambassador, to the end of 1808, responded to this literary present of fraternal love by a poem, which he sent from Albano to Alexander in Paris, and which the latter did not publish until after his brother's death. This poem bears evident tokens of the emotions of longing and of anxiety which William must have felt for his brother, wandering about in a foreign world-quarter, and gives us an insight into the happiness which their meeting in 1805 must have caused them.

It also reflects the great impression which these "Views of Nature," these grand descriptions of a foreign world, must have made on William von Humboldt, especially as he had already enjoyed the verbal description of the same subject. In this poem, William, after reading the book dedicated to him, transposes himself into the same wild and grand nature, in the midst of that undeveloped higher life, but describes also the self-consciousness and the hopes of this new world. He compares its poverty and its grandeur with the old world—compares the Pelasgians and Greeks to the American Indians, and reveals the great laws of historical existence which govern the two worlds, as Alexander had discovered their natural laws.

When Humboldt had returned to Paris in 1807, he devoted himself principally to literary activity, by directing the completion and gradual publication of the great results of his travels. But the fruits of his journey were so considerable, so varied, and entering into so many spheres of science, his studies and collections were so exciting for further research and comparison, that he had to unite with other scholars, and allow them to complete in a more

especial manner the various branches of science. The most eminent men of the age considered it an honour to be fellow-labourers in this gigantic work; they emulated each other in the sterling value of the contents, and the most accurate adaptation of the material afforded them. Artists and artizans strove to make the artistic contributions, the atlas, the landscapes, the typographic arrangements, as perfect and brilliant as possible. Although the great work required several years, and its completion extends to the latest period, and even into the future, we deem this a fitting occasion to give a sketch of this great literary undertaking.

The whole work, which is written in the French language, is subdivided into a series of pamphlets, which belong to the various special spheres of science. For the astronomic observations and barometric altitude measurements, Oltmann was employed, under Humboldt's superintendence and assistance; in chemistry and meteorology, the celebrated Arago and Gay-Lussac willingly assisted him with their knowledge; Cuvier and Latreille devoted their energies to the zoological portion; Vauquelin and Klaproth to the mineralogical part; and the Berlin professor, Kunth, was fellow-labourer in the department of botany. This assistance of celebrated scholars in special natural scientific branches, was inevitably required, if the work should have any chance of completion during a long human life. The materials which Humboldt entrusted to each fellow-labourer resembled a mine, from which every workman produced new treasures and pure gold for science. It was to be expected that the parts which gradually appeared would soon find translators and compilers, and thus it happened that the various single branches were translated into German and other languages by clever men, and were frequently enriched with new experiences and comparative descriptions.

As the original was written in a foreign tongue,—as it appeared only at long intervals, and was ex-

pressed in the severest scientific form, the great work was a treasurable and important one only for the really scientific, while the German nation in general had little insight into it, and only the German popularly written "Views of Nature" could be found on the library shelves of the educated classes. There were, indeed, some who endeavoured to popularize Humboldt's great journey, by transcribing interesting extracts from it, but yet the German nation, as a whole, gained no insight into the entire great importance of the results of Humboldt's acquirements for science and life. To innumerable persons Humboldt is yet a fabulously miraculous individual, over whom the report of mysterious adventures throws a supernatural halo.

The great work bears the title, "Voyage aux Régions équinoxiales du Nouveau Continent, par A. de Humboldt et A. Bonpland." Two editions of it appeared, one large and one octavo edition; the former consisting of three volumes folio, and twelve volumes in quarto, besides an "Atlas Géographique et Physique," and a collection of picturesque drawings, the latter intended to form twenty-three volumes. Four quarto volumes contain the real account of the journey—"Relation Historique," the fourth volume appearing after a long delay. The reader may judge of the immense comprehensiveness of this colossal work, by the length of time its completion required, in spite of the important assistance given to it; for although the first volume appeared nearly forty years since, its completion dates down to the present time.

In order to gain a comprehensive idea of the whole, according to its contents, we will enumerate the parts and their respective subjects, without regard to the period of their publication in single volumes or pamphlets.

The "Vues des Cordillères et Monuments des Peuples indigènes de l'Amerique," give us, in two folio volumes, with sixty partly black, partly coloured copperplates,

splendidly finished, a picture of the rich nature of the tropical countries, the mountain formation of the Andes, as well as clear descriptions of the manners, origin, migrations, languages, morals, laws, and worship of the inhabitants; and also inquiries into, and illustrations of, the ancient buildings and monuments of the old Mexican and Peruvian nations.

The "Essai Politique sur le Royaume de la Nouvelle Espagne," in two volumes, with the atlas belonging thereto, and also the "Essai Politique sur l'Isle de Cuba," in two volumes, give a clear insight into the state of Mexico and Cuba, in respect of politics and statistics, and still afford a rich source of knowledge, in spite of the great changes which have since taken place there.

The Zoology, the observations on animals which Humboldt made during his journey, are contained in a work of two volumes, entitled, "Recueil d'Observations de Zoologie et d'Anatomie comparées, faites dans un voyage aux Tropiques," at which Cuvier and Latreille actively assisted, and which comprehends an accurate description and interesting comparison of different species of animals, and many new facts concerning the earth as the dwelling place of animals. In Botany Humboldt's fellow-traveller was particularly active, and while Bonpland depicted the new specimens of a hitherto unknown vegetable world, having brought home more than six thousand species of new plants from America, Humboldt extended his view over the laws of vegetable life, and their relation to the earth itself. The great work, "Essai sur la Géographie des Plantes," which was in some sort a conclusion to Humboldt's treatise, "Ideas on the Physiognomy of Plants," in the above-mentioned "Views of Nature," and which was more extensively treated in the work, "Prolegomena de distributione Geographicâ Plantarum secundum cœli temperiem et altitudinem montium," proves in a genial manner, rich in experience, how important the influence of geography is on botany; it

shows how vegetable geography stands in closest relation to the life of plants and the study of climate, —how the number, the form, and the local distribution of plants, must differ according to the universal laws of the different zones, from the pole to the equator, from the depth of the mines and the bottom of the sea to the mountain-tops of eternal snow, according to the geographical latitude of the locality, and the constitution of the surrounding landscapes. This work may truly be said to have opened a new sphere in the science of botany: for the first time the relation of the medium temperature of a place to the atmospheric pressure, and the humidity and electric tension of the atmosphere, is explained, and that by his own measurements and investigations. To this work is added that beautiful picture of a vegetable geography of the tropics, the so-called "Tableau des Plantes équinoxiales," from the level of the sea to a height of five thousand metres, in which Humboldt gives a clever, æsthetic, but, at the same time, strictly scientific and pleasing picture of the vegetable world.*

* Vegetable geography is a new branch of botany really founded by Humboldt. After he had instituted the most comprehensive investigations into the laws of the distribution of plants, and shown their intimate connexion with the conditions of height and climate, and the chief points of a numerical calculation of the local distribution of plants over the earth, he formed a basis for this branch of natural science, whose development by himself and others has attained such a degree of completion, that it has not been without considerable influence on the civilization of nations. His writings on this subject, and the excellent illustrations accompanying them, contain an accurate distinction between the characteristics of the various forms of plants in the warmer regions. His description of the mountain Flora, rising terrace-like upwards, as well as of the social and the solitary plants, excited such a lively interest among all educated men, far beyond the bounds of merely scientific circles, that we must give a short sketch of his system. What would be a landscape without plants? They alone refresh and vivify, and thus they are the companions of man. But to describe their geography, one must be susceptible to their existence. Humboldt was so to a high degree; and this we may recognise, not alone from his classification of the varieties of plants, from his doctrine of the distribution of plants from the equator to the poles, and from the level of the sea to the boundaries of eternal snow, but more especially from his "Physiognomy of Plants," which reveals the intimate conformity of his comprehensive

The special explanation of the new discoveries in descriptive botany Humboldt left to his fellow-labourers, as he had at the same time to devote his energies to other fields of natural science. Thus Bonpland alone wrote two works, namely, "Plantes Equi-

mind with the mysterious life of plants, and their relation to the earth. The surface of plants which is spread over the world has had its HISTORY, its gradual distribution over the sterile earth, and its great epochs. If a volcano from the bottom of the sea suddenly divides the surging tide and forces a slaggy rock to the light of day, or if the coral insects gradually raise their edifice, after thousand generations, to the level of the sea, everywhere on the naked rock, as soon as it comes in contact with the air, the organic powers are ready to vivify the dead stone. The first vegetation on the stone begins with a coloured spot, gradually darkening and appearing to be streaked with velvet, an organic structure rises layerwise over the stone, and, as the human race must pass through certain grades of moral culture, so is the gradual distribution of plants dependant on certain physical laws Where high forest trees now raise their verdant tops, tender lichen once crept over the soilless rock—mosses, grasses, weeds, and bushes, fill up the unmeasured periods of gradual development between then and now. What the lichens and mosses effect in the north, the pontulace, the gomphrenes, and other low shore plants serve to effect in the tropics. This developement and advancing renovation varies according to the diversity of the climate. Periodically nature becomes dormant in the cold zones, for fluidity is the condition of life; only such plants can develope themselves here as are capable of supporting a temporary interruption of their vital functions, and a periodical deprivation of heat; but the nearer to the tropics the more varied are their nature, their graceful forms and colours. But in this increase from the poles to the equator each different climate has its peculiar beauties, excepting of course the sterility of certain large tracts of land in consequence of former floods or volcanic revolutions. The tropics, for example, have variety and size of form, the north enjoys the prospect of meadows and of the periodic awaking of nature—every zone has its peculiar character, its natural physiognomy. The descriptions of such landscapes need not only afford a pure delight to the senses, but Humboldt showed how the knowledge of the natural character of different regions of the world is intimately allied with the history of the human race and its civilization, how the tendency of the national character, how a cheerful or a depressed humour chiefly depends on climatic influences. The wonderful number of different species of plants, of which 56,000 have already been discovered on the earth, Humboldt divided into only a few well-defined classes, which form the basis of all. He did not classify them, as the systematical botanist does, according to the minute parts of the buds and fruits, but according to the entire impression which individualises a district, and by this means he established sixteen classes of plants which especially determine the physiognomy of nature. More will probably be found

noxiales au Mexique, dans l'Isle de Cuba, dans les provinces de Caracas, Cumana, &c.," in which he gave a methodical description of the plants in the Latin and French languages, with remarks on their medicinal virtues and domestic application. In another work, "Monographie des Rhexia et des Malasthomes" (plants which occur almost exclusively in South America, being principally trees and bushes, and of which all those which bear berries affording eatable fruit, which permanently colours the mouth black, whence their name), he described more than 150 specimens of new species of these plants.

Humboldt, besides this, united with the botanist

when the at present entirely unknown vegetation of South-eastern Asia, of central Africa and New Holland, of South America, from the Amazon to the province of Chiquitos, will have been revealed. In our temperate zones a certain monotony obtains; the physiognomy of our landscapes may be characterized by very few forms, which shrink more and more as they approach the pole, and become more varied and gigantic towards the equator. Like our animals, of which a lizard is there repeated as a crocodile, a cat as a tiger, lion or jaguar, the monocotyledons of our marshes grow in the south as majestic bamboos, as palms and uranies. The shrivelled needle leaves of our pines there unfold themselves as the immense leathery leaves of the bread tree, our German foliaceous moss grows to a tree-like form, our ferns are trees there like our alders and lindens. Humboldt characterizes the botanical forms in the following manner:—1. The *palm tree* as the highest and noblest of all plantile forms, the stem of which is often 180 feet high. 2. The *Pisang* or *Banana* form, which compensates for our northern grain in the torrid zone. 3. The *malvaceous* form, to which the monkey's bread tree belongs, which is probably the oldest and largest monument on our planet. 4. The Mimosa form. 5. Heaths. 6. Cacti. 7. Orchidaceous plants. 8. Casuari form. 9. Pines. 10. Pothos plants. 11. Lianas and vines. 12. Aloe plants. 13. Grasses, which, in the tropics often exceed in height our alders and oaks. 14. Ferns, often thirty-five feet high in hot climates. 15. Lilyplants, and 16. Willow form. The tropics afford the natural requirements for the production of all the representatives of the botanical world by its districts ascending from the level of the sea to the highest mountains. The inhabitant of the torrid zone may see all the plantile forms of earth without leaving his home, for he is surrounded not only by palm trees and pisang bushes, but by plants which, belonging, in a less stately and dwarfish form to the northern world, flourish there in imposing height and luxurious fertility. This short sketch will suffice to prove how interesting and attractive Humboldt's system is for every intelligent mind.

Kunth, and delivered to him the material for the compilation of several works, which have appeared under the titles, "Famille des Mimosacées et autres Plantes légumineuses;" also "Graminées Rares de l'Amérique Equinoxiale;" and "Nova Genera et Species Plantarum;" and of which the latter, seven folio volumes, with 700 copper-plates, describes 4500 plants which Humboldt and Bonpland had collected in America. A projected "Géographie des Plantes," which was to be illustrated by twenty copper-plates, of which several were to give a picturesque delineation of the character of the vegetation, was not realized.

In physics, geology, and astronomy, Humboldt also produced a number of works, which he either composed himself, or gave the materials from his rich treasures. With Altmann's assistance, two volumes appeared, called "Observations Astronomiques," which contain the calculated observations made by Humboldt between the 12th degree of south and the 41st degree north latitude, on the passage of the sun and the stars through the meridian, on the obstruction of planets and moons, on eclipses, refraction of light in the torrid zone, and barometric measurements of the Andes of Mexico, Venezuela, Quito, and New Granada, and which were accompanied by a chart on which 700 geographical localities are determined. A comparative description of all geological formations of the old and new world was given by Humboldt in the work, "Essai sur le gisement des Roches dans les deux Hémisphères," which was translated into German by von Leonhardt. The "Tableau Physiques des Régions Equinoxiales" contains a universal physical survey of the chief phenomena of natural and geological existence; and a special treatise "Sur les lignes Isothermes" gives the doctrine of climate, especially the fundamental principles of the medium temperatures of the earth's surface, which study he continued in subsequent years. The before-mentionod "Vue des Cordillères" contains many descriptions of physical life, which properly belong here; and a work.

important in its plan, and intended to extend to ten volumes in four divisions, called "Examen critique de l'Histoire de la Géographie du Nouveau Continent et des progrès de l'Astronomie nautique, aux XV et XVI siècles," with an "analyse raisonné" treating of the materials employed, was not translated into German until the year 1836, by Ideler.

As regards the time when Humboldt published the different portions of his American travel library; his essay on Botanical Geography appeared in 1805, at the time when he was visiting his brother in Italy; his Ideas on a Geography of Plants, and a Picture of the Natural Productions of the Tropics, appeared in 1807, when he was living in Berlin, at the same time that his Tableau of the Equinoctial Regions was published; his work on Equinoctial Plants was commenced in 1808, and continued to the year 1816; while Bonpland's "Monographie des Melasthomes" was commenced in 1809, and completed in 1816. In the year 1810 the first volume of the political essay on the kingdom of New Spain was published, at which Humboldt worked till 1815; in 1811 he published his Views of the Cordilleras; in 1815—1831 his "Hanptreisewerk," with the large atlas. His pamphlet on the isothermic lines (the lines which connect all places of the earth of equal mean temperature) was already published in 1817; in the same year appeared his "Introduction to Botanical Geography;" and at the same time he submitted to the Academy of Sciences in Paris his "Chart of the Orinocco, and its junction with the Amazon by means of the rivers Cossiquiare and Rio Negro." Professor Kunth superintended the publication of the "Famille des Mimosaceous Plantes" in 1819; of the "Révision des Herbes" in 1820; of the great "Synopsis of Botany" from 1822 to 1825; and Humboldt's political essay on Cuba was printed in 1826. Besides these works, Humboldt contributed to a number of journals, and wrote academical essays which cannot yet be enumerated collectively.

In 1844, when this gigantic work was still incomplete, the cost of a copy of the folio edition was 2700 dollars, about 405*l*. This is twice the cost of the celebrated French national work, "Description de l'Egypte," towards the preparation of which the government of that country advanced about one-eighth of a million of pounds sterling. A simple calculation will show how great must have been the expense of the whole work, when a single copy cost 2700 dollars (each dollar is worth 3s.); but it will become more evident when we state that the printing, paper, and copper-plates alone, have cost more than 226,000 dollars. And yet this important literary undertaking was not only realized and supported by the assistance of the purchasing public in all civilized states in Europe, but also by large voluntary pecuniary sacrifices on the part of Humboldt.

From 1808, Alexander von Humboldt lived principally in Paris. Towards the end of this year, William had been obliged to quit Rome, and his new political position in the Prussian state did not induce his return thither. He had been appointed councillor of state in the ministry of Home Affairs, and chief of the Section of Religion, and of Public Instruction; and in this very appropriate post he, by his representations, induced the king to decree the institution of an University in Berlin, in 1809. William von Humboldt was the soul of this undertaking, although the Lord Chancellor Beyme, the finance minister Von Altenstein, and the professors Wolff, Schleiermacher, Reil, and others, assisted him in its erection by word and deed. He induced the most eminent men to accept posts in the new institution; Gräfe of Ballenstadt, as surgeon; Reil, from Halle, as physiologist; Rudolphi, from Greifswalde, as comparative anatomist; Illiger, from Brunswick, as entomologist; Gauss, from Göttingen, as mathematician; Savigny, from Landshut, as lawyer; Fichte, from Erlangen, as philosopher; Niebuhr, from Halle, as teacher of political economy; Böckh, De Frette, and Marheinecke, from Heidelberg; and Alt-

mann, who had edited Alexander von Humboldt's astronomico-geographic collections, from Paris; and his dearest wish now, was to induce his brother Alexander to leave Paris, and honour the new university of Berlin with his name. But William von Humboldt was not to be present at the opening of the university founded by him; he was, on the 14th June, 1810, named extraordinary ambassador to the court to Vienna. His successor in the Department of Religion, Nicolovius, continued the work in Humboldt's spirit, and the chancellor wrote to Alexander von Humboldt, to Paris, to offer him the direction of the Section of Public Instruction. But the great task which Alexander von Humboldt had undertaken, and the labours of his literary work,—perhaps also, a dislike to official life,—induced him to decline the proffered honour.

William von Humboldt had gone to Vienna, where he was joined in the autumn of 1810 by his wife, who had till then remained in Rome. Here, again, his house became the centre of intellectual life; here he associated with Metternich and Gentz, with the counts Bernstorff and Stadion, with F. Schlegel, who was in the Austrian service, with Arnstein, Caroline Pichler, &c. But the following year brought, besides the youthful Theodor Körner, and the equally young Varnhagen von Ense, a welcome guest into the ambassador's palace in the person of his brother Alexander, who had left Paris after the publication of the first portions of his American literary trophies, to take leave of his family, as he had projected, and prepared for, another great journey,—one to central Asia and Thibet. The minister Romanzow had proposed to him to accompany a mission, across Kashghor, to Thibet, and Alexander at once assented, as he purposed visiting the celebrated mountains of India, and to study them in comparison with the Cordilleras of the new world.

This great plan, which was to be put in execution in the commencement of the year 1812, and which was already a favourite plan of Humboldt's, met with a sudden obstacle in the war between Russia and

France. Although his proposed journey was now frustrated, he did not lose sight of the once formed plan, and returned from Vienna to Paris, not alone to speed his American work, but also thoroughly to prepare himself for the perseveringly cherished plan of an expedition to Asia, with the hope of a future opportunity for its realization. With this view he occupied himself for several years with the study of the Persian language, so that he might, at his own expense, proceed to India by way of Teheran or Herat. He gained so accurate a knowledge of the structure of the Asiatic mountain-chains from literary sources that he was able to give critical judgments on the explorers who had travelled to the Himmalaya mountains. The idea of this journey had an especial charm for him; the mountain plains of central Asia, where old traditions fix the first seat of the human race, and the fabulous giant mountains of India, the curious circumstances of the boundary of eternal snow; all these things inspired him with an especial predilection for Asiatic studies. The French government had, in the interests of science, proffered its assistance to the execution of this plan, and even the king of Prussia, when he was in Aix-la-Chapelle in October and November 1818, had granted the celebrated naturalist an annual sum of 12,000 thalers, and the expense of preparing the expedition for this journey to Asia, but "particular circumstances," which we cannot reveal here, prevented the execution of his favourite plan, and he at that time relinquished it himself.

Before Humboldt's departure from Paris in 1818, we must look back on the year 1812, to mention an event which grieved Humboldt deeply when he heard of it in Paris. This was the melancholy intelligence that the town of Caracas, in which he and Bonpland had spent two months, and where they had been so hospitably entertained, had been destroyed on the 26th March, 1812, by a terrific earthquake, in consequence of which nine to ten thousand inhabitants were

killed under the ruins of their houses, and by the falling of the church during a religious procession. Humboldt exclaims, mournfully—"Our friends are no more; the house which we have inhabited is a heap of dust; the town I have described no longer exists. The day was hot, the sky cloudless, the air calm: it was Maundy Thursday, and the population was mostly assembled in the churches; nothing seemed to announce the threatened misfortune. It was four o'clock in the afternoon. Suddenly the bells, which were silent on this day, tolled; it was God's hand, not a human power, which rung the grave-bell. A shock of ten to twelve seconds terrified the people, the earth swayed like a boiling fluid. The danger was thought to have passed away when suddenly the subterranean thunder was heard. The town was utterly destroyed. The nine to ten thousand dead, of whom four to five thousand were buried beneath the falling church, where a solemn procession was taking place, were the more fortunate, as they were suddenly and unexpectedly overtaken by death when partly engaged in devotion and prayer, when we compare them to the unfortunate beings who, injured and wounded, survived their friends for months, and then perished for want of attendance and nourishment. The following night was calm and bright, the moon shone, the quiet heavens formed a fearful contrast to the earth, covered with corpses and ruins. Mothers carried the dead bodies of their children in their arms, mourning families wandered through the town seeking a brother, husband, or friend, of whose fate they were ignorant."

The vividness of this description, in which Humboldt transports himself to the desolated town, and enumerates his friends and favourite spots there, evinces clearly what a deep, painful impression the news of the fate of Caracas had made upon him.*

* Never, probably, has pity shown itself more active, or more inventive, than in the efforts which were made to extend assistance to the unfortunates whose sighs resounded in the air. Tools to dig up

We have already mentioned that Alexander von Humboldt left Paris in the end of the year 1818. Another separation had taken place in this year—an eternal separation for this world—from his friend and faithful travelling companion, Bonpland. The interest which this companion of Humboldt may claim from us in the dangerous pilgrimages and river passages of America, will excite some interest also in his subsequent fate. Soon after his return from America with Humboldt, he gained the esteem and affection of all with whom he came in contact, by his amiable character. As the Empress Josephine was passionately fond of flowers, Napoleon appointed Bonpland superintendent of the gardens of Malmaison, where a splendid collection of exotic plants already existed. When the empire was overthrown, he no longer liked to remain in France, and he went to Buenos Ayres in 1818, as professor of natural history. For a long time nothing was heard of him, until at last the intelligence of his misfortunes reached Europe, and consequently Humboldt's ears. Bonpland had, it

or clear away the dead were totally wanting, and hands had to be made use of to dig out those buried under ruins. The wounded and the saved were encamped on the shores of the Guayra stream, where the branches of the trees were their only roof. All beds, linen, surgical instruments, medicines, all the primary objects of human necessities, were buried under the dust, and for the first few days there was a want of provisions. The water had become rare—the aqueducts were destroyed, the springs choked. The interment of the dead was demanded by religious as well as by sanitary considerations; but it was impossible to bury so many people, and commissaries were therefore appointed to superintend the burning of the corpses. Among the ruins of the houses piles were erected, and this melancholy business lasted several days. Among universal lamentations the surviving population fulfilled religious ceremonies, by which they hoped to assuage the wrath of Providence. Some instituted solemn processions, singing funeral songs. Others, seized with insanity, confessed aloud in the streets. Eighteen hours after this terrible event new shocks were felt, accompanied by subterranean thunder. The inhabitants of Caracas dispersed; but, as the neighbouring villages had suffered equally, they could only find shelter beyond the mountains, in the valleys and Savanas. Enormous pieces of rock fell from the Silla, which Humboldt had ascended; and it was maintained that the two points of the mountain had been lowered by from 50 to 60 toises.

seems, proceeded into the interior of Paraguay, in 1820, to visit an Indian colony which he had founded at St. Anna, on the eastern shores of the river Parana. Scarcely had he arrived at St. Anna than he was surrounded by soldiers, who carried him off a prisoner and took him to St. Martha, after having destroyed the plantations of the colony. This violent proceeding was a revenge of selfishness which took place by command of Dr. Francia, dictator of Paraguay. The latter had long cast a jealous eye on the tea plantations which Bonpland had established on several points of Brazil, for the tea plant is peculiar to Paraguay, and forms the staple export of the country. His first command was, therefore, to seize on his rival Bonpland, on his next visit to the boundaries of Paraguay. The prisoner was detained at St. Martha, where he was allowed liberty of person, and was permitted to practise as a doctor. When Alexander von Humboldt heard of this attack on his friend, he was untiring in his intercessions with all his high patrons and friends, but his efforts had no effect in Paraguay. In the year 1829, the news arrived that Bonpland had attained his liberty, and had returned to Buenos Ayres.

In September, 1818, Alexander von Humboldt proceeded to London, where his brother William had resided for a year as Prussian Ambassador, and been particularly active at his post, for the suppression of piracy in the northern states of Africa and the extinction of the slave trade. But Alexander von Humboldt's presence in London was not to be merely a fraternal visit, as it was seven years earlier in Vienna, especially as William's wife had remained in Berlin on account of illness. The Allied Powers had commissioned him to compose a political survey of the South American colonies. But in October the King of Prussia summoned him to Aix-la-Chapelle, where he arrived on the 13th of the month, and remained with the king till the 26th November. Here his new plan of a journey to Thibet and the Malayan Archipelago was spoken of, and the king granted

him annually 12,000 thalers during the period of the journey and the expenses of the preparations. Humboldt was at this time so ardently full of this plan that he proposed to commence his journey in a few months, and it is therefore strange that he could so quickly relinquish it. William von Humboldt also came to Aix-la-Chapelle, on the 5th November, to be present at the last meetings of the Congress.

From Aix-la-Chapelle, Alexander von Humboldt returned to Paris, where he devoted several years exclusively to his studies.

CHAPTER VII.

JOURNEY TO ITALY WITH THE KING OF PRUSSIA—ASCENT OF MOUNT VESUVIUS—VISIT TO BERLIN AND TEGEL—REMOVAL FROM PARIS TO BERLIN—HUMBOLDT'S PUBLIC LECTURES IN BERLIN—FIRST SKETCH OF "KOSMOS"—OFFER OF THE EMPEROR NICHOLAS—THE SOCIETY OF NATURALISTS IN BERLIN—FAMILY AFFLICTIONS—APPOINTMENT TO THE CABINET—DEPARTURE.

WHILE Alexander von Humboldt was living a quiet and studious life in Berlin, the course of his brother William was a more animated and a more public one. On the 12th August, 1819, he was appointed Minister of the Interior with Von Schuckmann, but on the 31st December, he, with the Chancellor von Beyne, retired from the ministry into private life, in consequence of their opposition to Prince Wittgenstein and the Lord Chancellor Hardenberg. After this, William also devoted himself entirely to science and art, and his house—the first story in the house of Councillor Rush—was the meeting-place of the best society, including princes, ministers, scientific men, and distinguished women, such as Rahel, Beltina von Arnim, Charlotte von Kalb, Countess Schlabrendorf, &c. But he missed his brother Alexander in this brilliant circle of science and art, and it was his dearest wish that Alexander should change his residence in Paris for one in Berlin. But Alexander found all the intellectual resources he required in the great capital, and no other town was able to afford them. He was, besides, in constant personal intercourse with his scien-

tific friends and assistants, especially Arago, Gay-Lussac, Julian, Cuvier, Valenciennes; and the constant addition of new and strange elements, made Paris especially agreeable for his studies.

William had commenced the alteration of his mansion of Tegel in 1822, and on the spot where he and Alexander had spent their childhood, a splendid building now stood, whose interior was ornamented with productions of all branches of art. But another diplomatic appointment had nearly taken him again from Tegel. In 1822, the Lord Chancellor Hardenberg died in Genoa, and the minister Von Voss, who enjoyed the king's confidence, was fixed on as his successor, but also died, on 23rd January, 1823, which caused some embarrassment in the choice of a prime minister. The Count Kleist von Nollendorf, who would have been called to the post, also died, strangely enough, on the 17th February, and the king's choice would now, though not without hesitation, have fallen on William von Humboldt, had not other diplomatic considerations prevented Humboldt's return to office. The General von Witzleben had represented to the king that he was the only man completely qualified for such a high position. But he remained in Tegel, quietly devoting himself to arts and science, and thus had more leisure and time to welcome his brother Alexander on their paternal grounds.

When the king of Prussia proceeded to the congress of Verona, in 1822, Alexander von Humboldt, coming from Paris, met the king in Verona, and accompanied him from there on his journey through Italy to Venice, Rome, and Naples—an excursion which is of peculiar interest to science, because Alexander von Humboldt ascended Mount Vesuvius three times between the 22nd November and the 1st December; partly to repeat and correct his former barometric altitude measurements, partly to examine the edge of the crater, and its condition after a previous violent eruption. He had ascended it once before, with Leopold von Buch and Gay-Lussac, on the 12th August, 1805,

when he was visiting his brother in Rome, on his return from America.

Alexander returned to Berlin, from Italy, with the king of Prussia, and arrived there in the commencement of 1823, and was warmly welcomed in Tegel by his brother William. He spent some months of mental activity here, as not only the learned friends of Berlin eagerly seized the opportunity of his presence, to associate directly with the celebrated man, and draw from the rich spring of his knowledge; but he also obeyed the beneficial and agreeable impressions of home, and, in his brother's society, exchanged the memories and experiences of a new tropical world, on the spot of his earliest boyish dreams. During his visit to his beloved brother, those circumstances took place at court which we have already mentioned, and which had nearly summoned William von Humboldt, from the calm pleasures of a fraternal visit, into the restless, public, political world.

Berlin and Germany enjoyed the honour of harbouring its celebrated naturalist but few months. The desire to be near his fellow labourers in his great work, and the thirst for the magnificent resources of sciences in Paris, attracted him to the capital, where he was literally and practically active for natural science. But what fraternal love alone could not effect, was soon afterwards made possible by the king of Prussia's invitation. The king had formed a great partiality for Humboldt's person, and had expressed the wish that he would remove to Berlin entirely, that he might be the welcome companion and scientific adviser of his king. It was not royal favour, or vanity, or pride, which now determined Alexander to choose his native town as his dwelling-place; the wish of the affable king, who honoured science in Humboldt, only gave the impetus to a determination, whose deeper motives had been long working in the natural feelings of the noble man, and whose carrying out needed only that more powerful impulse to tear him from the chains formed in Paris by his scientific

pursuits. He had often felt and expressed the desire to live together with him from whom he had always been separated, although their characters were so similar, their talents so nearly allied, that they completed and assisted each other, and although most tender affection united them. He had determined to live for his brother William, when the king summoned him to Berlin.

In the autumn of 1826, Alexander von Humboldt went to Berlin to satisfy his king's wish, and to announce his approaching removal to his brother William. He only remained till the middle of December, as the change of residence required his presence in Paris, to arrange the commenced and projected scientific plans, to prepare his instruments and collections for the journey, and to design many works which his friends were to complete.

He was on the point of returning to his Prussian fatherland, in February, 1827, when a visit from Berlin temporarily gave a new direction to his movements. The count Bulow—William von Humboldt's son-in-law, who had accompanied him to London, as secretary of legation on his embassy, in 1827, and had married his daughter Gabriele, in 1821—had just been appointed ambassador to London, and was now proceeding to his post through Paris, without his wife and family, when he found a companion in Alexander von Humboldt. In London, Alexander was most honourably and kindly received by Canning; he, however, did not remain long there, but continued his journey to Berlin, through Hamburg. On the 21st May, 1827, William writes to his friend Gentz: "Alexander is here also, and has taken up his residence. He is more active and lively than ever, and we often speak of you."

Henceforward, Alexander remained in Berlin, though not uninterruptedly; he lived in the immediate neighbourhood of the king, and was often with him in Potsdam, accompanied him on his journeys, and only proceeded once a year, for some time, to the

French capital, which had, since 1804, been to him a second home, abounding in friends and in agreeable reminiscences, and opportunities for study. But he found the same also in Berlin. At his first arrival, he met Fresherr von Stein, who had come to Berlin on a lengthened visit, intended partly for the Humboldts. In May, A. W. von Schlegel arrived on a visit to his friends, after an absence of twenty years, for he had, through the exertions of William von Humboldt, been appointed professor at the then commencing university of Bonn; and his presence was rendered particularly interesting by his public lectures on the theory and history of plastic arts, which were delivered before a select audience. All these individualities exercised a beneficial influence on Alexander, and induced him to deliver a public lecture to the Academy of Science, on his favourite subject, the varieties of temperature on the earth.

But in July of the same year the two affectionate brothers had to separate again, and this time the reason was a sad one. William accompanied his wife, who had been ill for several years, to Gastein, as the bath had benefited her the previous year, and he could not bear to leave her in the then delicate state of her health. He cherished the hope also of meeting his friend Gentz there. The bath operated beneficially, and they returned to one of their estates towards the end of August, and to Tegel in October. But William did not remain long in his beautiful little castle, as a great intellectual treat summoned him to Berlin. Alexander von Humboldt commenced his lectures on physical cosmography on the 3rd November, 1827. The announcement sufficed to assemble all the intellect of Berlin and its vicinity to hear the celebrated naturalist.

As he had before done in Paris, in the French language, Alexander now, in his native tongue, gave the rich fruits of his researches in physical cosmography to the public, in a course of lectures delivered before a select but numerous assemblage. He enchanted his

hearers by the peculiar force of his intellectual clearness, and by his eloquence, by the genuineness and warmth of his feelings, and by the inexhaustible novelty of his subject; he stood before them as a convincing, inspiring teacher, who, like a talented creative artist, brought a series of wonderful natural pictures of a boldly-explored world before an attentive public. This course of sixty-one lectures, commenced on the 3rd November, and concluded on the 26th April, 1828, was, as it were, the first sketch of the "Kosmos," published subsequently as the result of his life and studies, given to the world in one work, whose contents may be compared to a mine rich in precious metals, and which such persons can best appreciate who already have a general knowledge of natural sciences.

The first lectures which Alexander von Humboldt gave in the university building, and which no scholar living within a practicable distance missed, caused such a great sensation, not only in the town but in all parts of the country, that scholars and friends of science frequently came from long distances to be present at least at one of these lectures, of which they could read the reports and effects in nearly every newspaper, and to be able to say they had seen Humboldt.

When some of the first lectures had been delivered, the press of people from all ranks was so great that Humboldt was literally forced to give a repetition of the first course, adapted for a more general public, nearly contemporary with the others, in the large hall of the Musical Academy. And these popular lectures were eagerly visited by the highest and the most learned persons in the town. The king, the royal family, the court, the highest lords and ladies, attended regularly and listened with the people, which showed its pride in the celebrated man by its enthusiastic admiration. Here Alexander stood immediately before his fellow-countrymen as an intellectual giant and inexhaustible spring of mental riches. Every one, even the lowest and most ignorant, heard

his name,—he was something wonderful, mysterious, and remarkable, and they thronged to see the man who had discovered a new world. His brother William wrote to a friend in Vienna, who considered every intellectually-uncommon development as something demoniacal:—"Alexander is really a '*puissance*,' and has gained a new kind of glory by his lectures. They are insurpassable. He is always the same; and it is still one of the principal features of his character to have a peculiar timidity and undeniable anxiety in the mode of his appearance."

These lectures of Humboldt were also new and remarkable, in respect of the position he took towards the people. For, while other learned men, whose social position is always higher than that of the people, nearly all, in their scientific and academic pride, did not deem it worth their while to disseminate their knowledge among the people, whom it must, ultimately, most benefit; while they generally keep their learning as the property and mystery of a caste, and interchange it among themselves; while they consider it *infra dig.* and degrading for a man of science to popularize his knowledge; Alexander von Humboldt set them the noble example, that a baron, a chamberlain, a privy councillor, and confidential adviser of his king, did not consider it beneath his rank and dignity to appear publicly as the teacher of his favourite science; he showed that a true man of science does not attach himself to an exclusive caste, and that all considerations of birth, rank, and title, are as nothing in the high service of science. And thus, Alexander, in the impulses of his heart and of his mind, fulfilled the noble duty which the mentally gifted man owes to his people—of bestowing on them, and instructing them with, the rich treasury of his knowledge and experience, thereby raising them nearer to himself.

William von Humboldt had waited for the termination of Alexander's course of lectures, in April, 1828, before he started on his last journey, which led

him, for a few weeks, to Paris, whence he visited London, in order to accompany his youngest daughter, Gabriele, thither, who had been married to the Prussian ambassador, Von Bülow, and had hitherto remained in Berlin. His wife and eldest daughter accompanied him, with the intention of visiting Gastein on their return, while Alexander, who at first intended to proceed to Paris with his brother, was detained in Berlin by important affairs. His public lectures on physical geography had excited the universal wish that he would reprint them for the general public, and thereby make them available for such students, whose distance from Berlin had precluded them from hearing the famed lecturer. This wish had become an universal one in Germany, and was urged most pressingly in all the public journals. At last, Alexander von Humboldt consented to prepare his lectures for publication, under the comprehensive title, "Kosmos."

But this great work was first interrupted, then delayed for several years; and, "Kosmos," enriched with new views and experiences, was not given to the world until years after.

Humboldt had long secretly cherished the plan of a journey to Asia. The Russian minister, Romanzow, had offered him an expedition to Thibet, in 1812, which, as we have before stated, was prevented by the French campaign against Russia. When Humboldt met the king of Prussia at Aix-la-Chapelle, in November, 1818, his favourite plan of exploring the highlands of central Asia, and, if possible, the gigantic mountains of India, those legendary districts promising rich fruits for scientific research, had induced the king to offer him a sum of 12,000 thalers annually, for the duration of the expedition. The plan was not executed at the time, but by no means abandoned.

The Emperor of Russia had again agitated the subject in 1827, at the time when Alexander von Humboldt was busy with his public lectures. The Emperor Nicholas made him the magnificent offer

of forming an extended expedition in the Russian dominions at his sole cost, with the express injunction to consider the advantages which the Russian government might draw from his researches in the mining capabilities of the country merely as of secondary importance, and to devote himself solely and entirely to the advancement of science.

Humboldt could not refuse such a proposal; but that he did not at once, in the spring of 1828, make use of it, shows the highmindedness of the man, for he held it to be his duty first to complete his public lectures, and to sacrifice his personal desires to the promise he had given to the public. But he deferred his publication of the lectures to prepare for the great journey to be commenced in the spring of 1829, and to arrange his plans with the other naturalists whom he was to choose to accompany him.

Humboldt's devotion to natural science made the year 1828 important far more than the preparations for the Asiatic journey. For the purposes of comparative researches, he caused the temperature to be measured in all the Prussian mines, and this led Humboldt's reflective and comparative mind to new results; and besides this, he was occupied in the autumn of this year by the seventh annual meeting of the German naturalists and physicians (an institution originated in Oken), which held its sittings in Berlin this time, and elected Humboldt, and Lichtenstein, as presidents for the year.

Here Humboldt's penetrating mind was again revealed in his just conception and comprehension of science and its duties, which consist partly in extending and popularizing knowledge, partly in exciting to further inquiries, in gaining new disciples, and in making itself of practical utility in life, and of educational service for the people.

These annual assemblies failed to fulfil their purpose, partly because the different branches of natural science were not properly separated from each other, and the constantly-increasing material could not be

surveyed, and certainly not arranged in the few days that the assembly lasted. Humboldt soon recognised this imperfect arrangement, and caused the institution of sections for the various special departments, in which every one had the privilege of an interchange of progress, and only the universal matter of general science was debated in the general meetings. Humboldt opened this seventh annual convention with a profound speech on the spirit and utility of such annual meetings, and his words had, as always, such a deep influence over the whole intellectual world, that soon afterwards annual convocations were instituted on the model of the Society of Natural Historians in England and in Italy.

But the year 1828, spent by Alexander von Humboldt in working for science, and in preparations for his great Asiatic journey, also brought an event which afflicted him deeply.

We have already stated that the wife of William von Humboldt had been ill for several years,—that she had frequently visited the baths of Gastein for the benefit of her health, and that she had, after the termination of Alexander's lectures, accompanied her husband to Paris and London, to use the baths on her return. When she returned to Tegel, with her husband, in the middle of September, her chronic disease attacked her with greater violence than before, and by the end of November, she was lying in constant expectation of her approaching dissolution. What Alexander must have suffered we can judge by his feeling heart, which had so often revealed itself in his life, and in his works. What must have been his feelings when he saw his ardently loved brother grieving inconsolably by the death-bed of his adored wife; and when he felt the last hour of his dear sister-in-law, so pre-eminent for all the virtues of heart and mind, inevitably approach! The dissolution did not take place as soon as was anticipated; she survived the new-year's-day of 1829, and on Sunday, the 22nd of January, when Alexander had been with her in Tegel,

he writes to his friend Rabel these few words, which will express the deep grief he felt: "She was dying; opened her eyes and said to her husband, 'Another human being is ended.' She expected her death, but in vain; she lived again, and took an interest in what was going on around her. She prayed much."....

In this condition she lay until the 26th of March, 1829, on which day it was announced in Berlin, under universal mourning, that death had released her from her sufferings. Her early death was an unfortunate event, for her travels had brought her into intimate relation with all the celebrities in science and art; her house had always been the centre of the most agreeable and intelligent society in Rome, Vienna, Paris, and Berlin. We can imagine what Alexander must have suffered, when we know his brother's grief. Both brothers, so intimately and affectionately united, in life and in study, always shared joy and grief with each other. William's love for his wife had increased each year, and her death again revived, and heightened that sentimental devotion, which had been in his youth a feature of his character. The thought of his wife seemed to him an intercourse with a higher world; her image was never absent from his soul; it entered into all his thoughts, and ennobled his own existence. Alexander von Humboldt remained for some time with his brother, and we may assume that the departed one was often present to his mind, for she was the nearest female friend he had related to him by blood and affection; as he had never known the ties of conjugal tenderness, his heart could only have been occupied with the delightful picture of his brother's matrimonial happiness. After the death of his wife, William was almost exclusively occupied with the plan of a monument for the departed one, whose remains rested, until its completion, in a spot of the church-yard of Tegel chosen by herself.*

* This monument was executed by the sculptor Rauch, and erected in the park of the mansion. An alley of cypresses leads to it; and, on the top of the monument is placed a marble statue of Spes, expressly made for Madame von Humboldt, by Thorwaldsen.

Recreation and employment were now absolutely necessary for William, to divert his mind from its grief in the one exclusive direction. Alexander had hitherto consoled his brother, and endeavoured to cheer him, but the time had arrived when he was obliged to leave him for a long period. The service of science called him away.

He was to leave Berlin on the 12th April, 1829, to commence the great expedition into Central Asia, his famous second voyage into the interior of the great Russian empire, to the Ural Mountains, Altai, and the Caspian Sea. Before his departure he probably felt that his mourning brother should not be left in the solitude of the Castle of Tegel, at the grave of his Caroline; and it is probable that he had requested the king, who had become more his friend than his patron, to divert his brother by official employment, for soon after Alexander's departure, the king summoned William to Berlin at the head of a commission for the interior arrangement of the new museum, and this new sphere was most excellently adapted for him, as he was quite *au fait* in these matters, and as he was obliged again to enter into nearer intercourse with well-known men, such as Rauch, Tiech, the sculptor; Schinkel, the architect of the museum; Wach, the painter; Waagen, afterwards director of the picture gallery; and Hirt; also with the art-loving Crown Prince, the present king Frederick William IV., and with the other intellectual circles of Berlin.

But Alexander also received a new public token of royal favour and esteem shortly before his departure. Although it could not fail that a scholar living in the court of his king, who, by his birth, his travels, and his reputation had come into contact with foreign princes, should receive also the symbols of honour and acknowledgment from the highest person in the realm, and should not want the outer decorations of life, it will not be considered superfluous if we mention that before his departure to Russia a rank was conferred upon him which rarely becomes the share

of learned men in Germany. Alexander von Humboldt was appointed an acting privy councillor with the title "Excellency." It was the rank of a minister, and showed that he was the most capable of representing the mind in the kingdom of science, and most proper for governing the realm of knowledge.

On the 12th April, Humboldt left Berlin, after an affectionate farewell from his brother, and we must prepare to accompany him on his new journey.

CHAPTER VIII.

JOURNEY TO RUSSIA WITH G. ROSE AND EHRENBERG, IN 1829—KASAN AND THE RUINS OF BULGARIA—EXPLORINGS IN THE VICINITY OF JEKATHARINENBURG—THE FEARFUL BORABINSKI STEPPES—ARRIVAL IN THE CENTRE OF ASIA—WAY TO THE SOUTHERN URAL DISTRICTS—FROM ORENBERG TO ASTRACHAN—RESEARCHES AND JOURNEY ON THE CASPIAN SEA—RETURN—RESULTS OF THE ASIATIC JOURNEY.

ALEXANDER VON HUMBOLDT had communicated with Gustav Rose and Ehrenberg, two naturalists, living in Berlin, and had induced them to accompany him on his projected journey. Each of the three travellers had a special branch of activity allotted to him, so that it might be more easily possible to superintend and arrange the rich materials certain to accrue on this journey. Humboldt undertook the observations on magnetism, the results of geographical astronomy, and the general preparation of the geognostic and physical plan of North-Western Asia. Gustav Rose undertook the chemical analyses of mineralogy and the subsequent keeping of the travelling diary, while the botanical and zoological labours fell to Ehrenberg's share.

The munificence of the Emperor Nicholas does indeed deserve warm acknowledgments, and has been of great advantage to science, which owes it to these not inconsiderable sacrifices of the Russian government that long existing errors have been cor-

rected, and great progress in the study of the physiology of the earth has been made. Therefore Alexander von Humboldt states in his dedication to the Russian emperor that he had vividly appreciated the munificence shown to him in the mountains of the Ural chain and on the shores of the Caspian Sea, where the importance of this expedition and its results were most plainly revealed to him. The emperor had granted that the localities which Humboldt was to explore should be left entirely to his discretion, as the chief aim had been the advance of science, especially of geology and of magnetism, which is of such importance in the present time, and that the material and local interests of the country were only to be secondary considerations.

The Russian minister of finance, the Earl of Cancrin, who has done much for scientific plans and purposes, had made the most appropriate arrangements for the comfort and security of the travellers, and to facilitate their expedition in general. A Russian officer, subsequently the inspector of mines, Von Menschenin, was appointed as Humboldt's constant companion, to give him every information on ways and localities, and to levy the necessary assistance from the Russian authorities; thus prepared, and furnished with all the comforts of Russian hospitality, they left Petersburgh on the 20th May, and proceeded to Moscow. At Nischnei-Nowgorod they embarked on the Wolga, and arrived at Kasan on the 4th June. When they had visited the Tartar ruins near Bulgari, the ancient capital of the Moguls, they proceeded over Perm to Jekatharinenburg, on the Asiatic side of the Ural mountains, where Humboldt, during a stay of four weeks, made a series of important observations on the central and northern portion of the mountain ridge. The mountains here afforded him a highly interesting sphere for investigation, in their situation, their form, and their metallic formations. This ridge, consisting of several nearly parallel lines, whose highest point

rises to a height of 4500 to 4800 feet, was extremely remarkable, as much for its extent, as for its direction in the meridian, which was in a line standing perpendicularly upon the equator from the pole, and which reminded Humboldt of a similar situation of the chain of Andes which he had explored in America. These Ural formations—beginning on the sea of Aral, with so-called tertiary formations,* and extending to the greenstone rock on the Arctic sea—contain gold and platina in their northern and central portions, principally where alluvial deposits predominate. This circumstance urged Humboldt to especially interesting inquiries, and he gained, spite of his short stay of four weeks, such important results, and new disclosures on the composition and formation of the gold and platinum contained in alluvial soil, he discovered such a large quantity of new minerals, and made such highly important observations on the relative positions of the various rocky formations, that we should be more surprised if we did not know Humboldt's unwearying industry, and his unusual and practised talent for observation.

When he had visited the malachite† pits of Zumeschefskoi, the remarkable magnetic mountain, Blagodad, and the famed deposits of topaz and barytes, near Murzinsk; after he had found a piece of pure platinum, weighing more than eight kilogrammes,‡ near Nischnei-Tigilsk, a district which reminded him of Choco, in South America; and when he had, besides this, fixed the astronomic position of several localities, and made several magnetic and altitude measurements, he continued his journey from Jekath-

* By this is understood the strata of earth lying beneath the superficial layers of more modern times, and which consist of upper peat, of coarse lime, and of lower peat.

† Malachite is carbonated oxide of copper. It is generally met with in veined radiating groups; is of silky lustre, and of a fine emerald green colour. It sometimes also occurs in coarse, earthy masses, and crystallizes in irregular rhomboidal cones.

‡ A kilogramme is nearly equal to two pounds six drachms.

arinenburg over Tjumen to Tobolsk, on the Irtysch, and thence over Tara, through the fearful steppe of Borabinski. This steppe is notorious in the whole country, and dreaded by all in its vicinity, for its innumerable stinging insects of the genus *Tipulæ*, but nevertheless Humboldt and his companions traversed it with the same disinterestedness and devotion to the cause of science which we have already had occasion to admire in the heroism of this great naturalist during his Orinocco journey. On the 2nd August he reached Barnaul, on the shores of the Obi, and now the travellers explored the picturesquely-beautiful Kolywanlake, and the rich silver mines* of the Schlaugenberg, of Riddersk, and of Zyrianowski, situated on the south-western side of the Altai mountains. The highest point of this ridge, the mountain Bjelucha, called by the Calmucks, God's Mountain, Jyctu, or barren mountain; Alastu is of about the height of Mount Etna, or, according to the investigations of the botanist Bunge, equal to the Peak of Teneriffe. From Riddersk, Humboldt and his companions turned southward to the little fortress Ust-Kamlenoigorsk, and crossing Buchtorminsk, arrived on the boundaries of the Chinese Dsungarei. Here he obtained permission to cross the boundary, which he at once made use of to pay a short but interesting and productive visit to the Mogul settlement of Bate, also called Chonimaila-chu; and where he entered the real Asiatic district of the proximate centre of Asia, situated north of the Dsaisang lake, on the 17th August.

The return from here to the fortress Ust-Kamenoigorsk was highly interesting for its geological value, and was suggestive of new researches; for as he was sailing back down the Irtysch, he saw on the secluded shores of these waters, on a surface of more than 16,000 feet, immense rocks of granite, lying horizon-

* It may be imagined how considerable these mines are from the annual proceeds, which amount to above 76,000 marks, or 4[illegible]342 pounds.

tally and in layers, and resting on clay-slate, whose layers were partly perpendicular, partly in an angle of 85 degrees. This was a highly-important fact for Humboldt in his theory of the formation of granite.

When he had again arrived at the abovenamed fortress, he proceeded thence through the steppe of Ischim, which belongs to the central tribe of Khirgises, to the southern portion of the Ural chain; he crossed the line of the Cossacks of Ischim over Semiplatinsk and Orusk, and arrived at Mjask. From here, frequent excursions were made into the vicinity. On a district of inconsiderable extent, and only a few inches below the surface, three pieces of pure gold were found, of which two weighed 28 and the third 43¼ marks (18 and 28 pounds). The course of the southern Ural was followed as far as Orsk, where the remarkable quarries of green jasper attracted Humboldt's attention, and where his geological studies found abundant scope in the river Jaik, which crosses the mountain-ridge in a north-western direction.

Humboldt now turned his course to Orenburg,* where he arrived by the road over Guberlinsk, on the 21st September. Here in Orenburg, where caravans of many thousand camels arrive yearly, Humboldt made the acquaintance of a certain Herr von Gens, who was a very intelligent man, and interested himself particularly for the geography of Asia, for which he had collected a quantity of important materials. He had travelled far, and Humboldt gained many useful explanations and descriptions from him. Among others, he learned of a high mountain, which had once been a volcano, and which still disturbs the passing caravans by storms which it is said to occasion, and whose anger the inhabitants propitiate by sacrifices of sheep, situated to the north-east of the great Balkasch lake, which receives the waters of the river Sli. Gens had this communication from a Tartar,

* Orenburg lies below the level of the sea.

and Humboldt at once remembered the volcanos mentioned in Chinese books as lying far from the ocean, and which had excited much surprise among geologists in Klaproth's and Amusat's literary descriptions. Humboldt subsequently obtained more accurate information from the Russian police-director of Semipalatinsk, von Klostermann. He devoted special attention to this subject, and on his return composed a highly interesting sketch of the geography of this little-known district, with the object of bringing the remarkable volcano into organic relation with the other phenomena and conditions of the district.

The famed rock-salt mines of Jlezk, in the steppe of the minor tribe of Kirghides, and the chief station of the Uralskian Cossacks, was the next point on his journey. Then he arrived at the German colonies on the Wolga, in the department of Saratow, at the large salt-lake Elton; and then visited the fine colony of Moravian brethren in Sarepta, and arrived in Astrachan, on the Caspian Sea, in the middle of October.

His chief objects in this expedition to the Caspian Sea were to analyze the waters of the largest inland sea of the world with chemical accuracy, and to discover its constituent elements—a task which Gustav Rose undertook; then to make barometric measurements comparative to the measurements in Orenburg, Sarepta, and Kasan, and to collect zoological treasures. The specimens of fish from the Caspian Sea were to complete the work on fishes by Cuvier and Valenciennes,* and Humboldt arranged a little excursion by steamer on this lake, for the purpose of collecting them.

From Astrachan they returned to Moscow, over the isthmus which separates the rivers Don and Wolga, near Tischinskaya, through the territory of the Don

* Of the fish here caught, Humboldt sent a very complete collection to the Museum of Natural History, in the Botanical Gardens of Paris.

Cossacks, across Woronesch and Tula, and arrived in Petersburg on the 13th November. Humboldt remained here only as long as his obligations to the government and court required, and until the receipt of his specimens, and arrived safely in Berlin on the 28th December, 1829.

Humboldt had been absent from Berlin from the 12th April to the 28th December, and such a considerable territory has probably never been explored in such a short space of time. During eight months and a half he had travelled a distance of 2500 geographical miles on land.

This journey, like the American one, was of immense importance for the physical-geographical sciences in their most extensive form. The marvellously extensive materials which Humboldt brought with him, and their application to a just comprehension of the nature of the earth, would not bear compression into a condensed, popularly comprehensible description. The results of the journey were therefore to be published in three works, of which each of the travellers undertook to prepare one. Humboldt's "Fragmens de Géologie et de Climatologie Asiatique" was the first to appear; a portion of it, however, only flowed direct from Humboldt's pen, and it contains much varied matter, very productive for further scientific works, and which has been enlarged by Klaproth with important notes.

These Asiatic fragments can only be considered as the forerunner of a greater work; but we must indicate its general contents to show what were Humboldt's chief studies and researches during this journey to Central Asia. The first volume of the original French work treats especially of the mountain-ridges and volcanoes of Central Asia, with additional remarks on the thermo-waters of Alagut, and on the gas-mud and fire eruptions on various spots of Central Asia and America. This shows how Humboldt constantly compared and combined his new discoveries and experiences in Asia with those of America, and

created a picture of the entire earth and its laws from the results of his comparisons. He has everywhere interspersed numerous geognostic observations and notes on the general formation of the soil between the Altai and the Himalaya mountains, and his communications on the remarkable occurrence of volcanoes in the middle of the continent, and far from the ocean, are of great interest. Here Humboldt placed science on a new footing, for he had had the special opportunity of observing the volcanoes in three different quarters of the world. He perceived that the volcanic phenomena could no longer be considered as belonging to geological developments, but that they must be explained by physical history in general, as the volcanic activity seemed to him to be the result of a continual communication between the interior of the earth, which is in a molten fluid condition, and the atmosphere which surrounds the hardened and oxydised crust of our planet. On this theory he explained the still active and the extinct craters, the direction of the mountain-ridges, and the formations of the soil; he deciphered the traces of former terrestrial revolutions, their relative age, and the physical powers which have influenced and still influence the form of the earth's surface. Thus the masses of lava which pour from the craters were to him the petrified streams of formerly gushing springs of the interior of the earth; from the connexion and similarity of effects he traced the causes and conditions of the formation of rocks and superincumbent strata, of the chemical results of volcanic eruptions, of elevations and depressions of the earth's surface. By the strictest investigation of all occurring new appearances, and by penetrating combination of analogous, observed facts, he explained numerous physical and geological problems, whose exact solution had hitherto been deemed impossible. Humboldt thinks that the volcanic activity of our earth, compared to former ages, is considerably decreased; it can no longer bring forth new elevations or heat in the north, but can only produce small

craters, and an agitation of the earth's surface. Before the advent of man into terrestrial nature, a tropical animal and vegetable world flourished everywhere on the volcanically heated earth; now, on the cooled planet, the petrified surface only receives warmth from the sun, the tropical luxuriance died out towards the north, and only flourishes where the sun can exercise its perpendicular influence over the tropics.

In those remote ages of the boiling centre of our earth ball, the hot fluid and the gases it generated often and on many points burst through the firm crust with tremendous force, made clefts and depressions in it into which the molten masses of metal, basalt, and other matter flowed, which were petrified, and now lie in the thus-formed mountain ridges. Thus arose the Cordilleras of the Andes, the Himalaya mountains, and thus was petrified the waving surface of the broken soil into those hills and valleys which transform our plains into picturesque landscapes. From these causes Humboldt explained the peculiarities of the Asiatic soil. The volcanic power which raised mountains and continents, and swelled up the earth-crust bubbling like a gigantic vault, had the consequence that these hollow vaults sank down in the course of ages, and thus Humboldt established that the depression of the surface of the old world, where the level of the Caspian sea, like that of the sea of Ural, lies 32 to 50 toises below the level of the ocean, and where the depression of the firm soil extends as far as Orenburg, Saratow, and south-east probably as far as the so-called central plain, is nothing but a crater-land like that of the moon, where the large points, above 100 miles broad, called Hipparch, Archimedes, and Ptolemy, form a basin formation such as exist also nearer home, for instance, in Bohemia.

Before Humboldt's journey into the interior of Asia, there existed many erroneous notions of the geography, the connexion of the mountain chains, and the productions of the soil of those districts, but an

entirely new view of the country was acquired through this bold and penetrating traveller, who made a large number of independent latitude measurements, and who obtained varied information on travelling routes and local circumstances from travelled Tartars, Bulgarians, and Taschkents, as well as from the Russian officers. The inner, central part of Asia was not, as had been supposed, an immense agglomeration of mountains, nor an uninterrupted table land, for Humboldt established that this part of the world was crossed from east to west by four mountain-systems (by the Altai, which ends westward in the Kirghiz district, by the Himmelsberg, by Kuenlun, and by the Himalaya), which have exercised authenticated influence on the historical migrations of nations. And thus Humboldt discovered a volcanic territory in the centre of Asia, which is 1000 to 1400 miles distant from the ocean, and which presents a surface of 2500 geographical miles.

The second volume of the "Asiatic Fragments" contains, beside the description of the twelve routes, "Observations on the Temperature and the Hygrometric Condition of the Atmosphere in some portions of Asia, and Investigations into the Causes of the Deflection of the Isothermic Lines,"—*i. e.*, the imaginary lines which unite all points on the earth of equal mean temperature. In this volume we have important contributions to a climatic knowledge of that country, and in it are indicated also the causes which produce the deflection of the isothermic lines from the parallel circles.* These results, based on numerous astronomic and magnetic measurements, throw an entirely new light on this branch of science, and are again closely connected with the results of the former American journey, as Humboldt had there also construed the terrestrial laws from similar phenomena in the old and new world.

* The parallel circles run parallel with the equator, and the mean animal temperature generally decreases with their increasing breadth —the approach to the poles.

We must devote especial attention to this subject, —the isothermic lines,—because it plays a very important part in Humboldt's scientific life, and has occupied him much during his whole career as the favourite branch of his studies. In the year 1817, when he published his essay, "De la distribution de la chaleur et des lignes isothermes," in the third volume of the French journal, *Memoires d'Arcueil*, he had already paid great attention to the distribution of heat over the earth, and had endeavoured to determine the direction and form of these isothermic lines more accurately. He also gave a lecture ten years subsequently, on the 3rd July, 1827, before a public meeting of the Academy of Sciences, on the chief causes of the varieties of temperature on the globe, and in his Asiatic fragments, he communicated his detailed investigations and increased experiences upon the subject.

Alexander von Humboldt begins by treating of the climatic condition of Asia, and herein entirely follows the impressions of his accurate comprehensive geographical acquirements, and at the same time extends the subject to the entire earth, and goes back to its universal laws. On this field many errors had to be corrected, and science had to be raised to a new grade. It was formerly believed that the coldness increasing from Europe towards the east was caused by the elevation of the ground above the level of the sea, but it has now been plainly proved by facts that this is not the case, and that, on the contrary, one may travel from the Brabantine heaths eastward, as far as the Asiatic steppes on the western declivities of the Altai, a direct line of 80 degrees of longitude, without crossing an elevation of 1200 to 1300 feet. And travelling in a higher latitude from the Brabantine heaths to the Asiatic steppes, one would cross only unbroken plains as far as above the 65th degree of latitude, a distance of nearly half the earth's circumference. This Humboldt perceived, and that therefore the climatic changes must have other causes than

the hitherto accepted ones; he developed these facts with skilful application of the rich store of experience he had had the opportunity of collecting in two different quarters of the globe. When he compared the European remarkably warm winter temperature with that of Asia or America in the same latitude, he could no longer, from his experience, content himself with the already-accepted explanation of the unusual European warmth; it had hitherto only been customary to search for the causes of the coldness in Asia and America, without at the same time considering the warmth of Europe, and looking upon it as an anomaly. Humboldt perfectly enlightened science on this point; he perceived the reason of the winter warmth of Europe to lie not only in the general form of this quarter of the world, but also in its position beside a large, hot Asiatic zone of continent, which is much more heated by the constant influence of the sun's rays than the mobile and self-cooling ocean which surrounds the other quarters, and which sends its rising warm atmosphere over the plains of Europe, which have a warm winter. A still more important cause of heat he finds in the current of the ocean, called the gulf current, because this current perpetually drives the heated waters of the American torrid zone to the north-east, and its warm exhalations float particularly across the coasts of Great Britain, Ireland, and Scandinavia. Therefore, the west and south-west winds, moving in the same direction with this warm ocean current, blow over the northern part of Europe as warm currents of air impregnated with warm moisture by the exhalations of the sea; they modify the severity of winter, but as they discharge their warm moisture, they cool more and more, and reach the Asiatic plains as dry cold winds. The west wind, therefore, which brings us damp warmth, brings dry coldness to the inhabitants of the Asiatic plains, and while Western Europe has an insular coast climate, Eastern Europe has more a continental climate, with regularly opposed warmth of summer

and frigidity of winter; and although on the southern boundary of Siberia the constantly and perpendicularly-falling rays of the sun must generate heat, this has no other consequence than that a very hot summer there succeeds a very cold winter. Humboldt nowhere found finer grapes than in Astrachan, on the coast of the Caspian Sea; and yet here, and still further south, in Kislar, at the mouth of the Tarek, in the same latitude as Avignon and Rimini, the cold in winter is from 28 to 30 degrees of Celsius' thermometer. Humboldt calls this great contrast between summer's heat and winter's cold a peculiarity of Siberia; the vines there must be buried deep in the earth in the winter, and in summer, on account of the dry heat, they have to be artificially refreshed by water. As high as the 58th degree of latitude, Humboldt could ascertain the mean temperature of the localities with tolerable accuracy from the temperature of the springs. A little further north the ground remains constantly frozen to a depth of from 12 to 15 feet, while in Norway, which is as near if not nearer the north pole, fresh moss and grass grow beneath the snow, even in winter. Humboldt had a spring dug in Bogoslawsk in the middle of winter, and came to ice nine and a half feet in thickness six feet below the surface, and it is remarkable that, in spite of these subterranean masses of ice, the short but powerful summer's heat quickly thaws the upper crust, and produces a very abundant harvest.

All these observations, with others arising from them, and further investigations, were combined to geological truths of scientific importance in Humboldt's active mind. From these causes, he solved the formerly inexplicable riddle, how remains of animals whose organization belonged to a hot climate—for example, even the mammoth—had been found in a state of decay in the iceblocks of these northern regions. Not long since, East Indian tigers were exhumed there, in the same latitude in which Hamburg and Berlin lie; and it is Humboldt's

opinion that the southern animals had wandered too far north into higher latitudes in hot summers—especially in former ages, when, by the greater volcanic activity of the then hotter earth, those northern regions, also, must have had a higher temperature—that they had been suddenly overtaken by the winter, and had been buried in ice which has not melted since that time; and that inundations of rivers, flowing northward, on whose shores numerous remains of southern animals may yet be found, may have washed them towards the north.

Humboldt also acknowledged the direction of the winds and tides, as one modifying cause of the climate prevailing over certain large portions of land, and these again stand in intimate relation to the form of the continent, and often divert the isothermic lines considerably from their regular course. This explained, clearly, how two countries or districts lying under the same degree of latitude, but at a great distance from each other, could have two entirely different climates.* Humboldt showed how the revolution of the earth on its axis must cause the great current of the waters of the ocean to flow from east to west, and that this current must be the strongest at the greatest peripherium of the earth, beneath the equator; that another current from the poles towards the greatest peripherium, must necessarily co-exist, which must flow from the north pole, first towards the south, and then westward, following the chief current.

The cold waters coming from the polar circles therefore, wash the eastern shores of the countries of the earth, while the heated waters, flowing back from the equator, beat against the western coasts. The prevailing winds blow analogously with these ocean tides; and hence the coldness of the eastern, and the warmth of the western coasts, are self-evident We

* These theories of Humboldt have been worked out by Schouw and Dowe, who have founded many important facts on this basis.

can, therefore, not be surprised at the coldness of Northern Asia, as the north-east winds prevail there.

Humboldt has also extended these studies on climate, to the special local influences; and has scientifically explained the co-existing effect of the rays of heat. This radiation of heat is variously modified by the nature of the soil, its cultivation, its vegetable world, even by the form of the plants, and situation, and direction of their leaves; it reflects the warmth generated by the sun's rays, from the surface of the earth back into the atmosphere, and exercises a great influence on the climate.

In this way Humboldt established a climatology, for which he had collected the elements as a favourite occupation, from the commencement of his studies; he gained rich material from his own experience, and did not reject the experience of others, which he was able, in his own genial manner, justly to apply.

But the Asiatic journey became of vast importance in its more extensive results. Where Humboldt could not himself institute observations, he arranged further studies for others, with prudence and foresight. In many parts of Siberia, he left carefully compared thermometers, in the hands of competent and intelligent persons, and awakened the taste for these measurements and comparative experiments, especially among the Russian mining superintendents of the Ural mountains. In addition to this, he gained the assistance of the imperial academy of St. Petersburg, by submitting to them an excellently regulated plan for instituting over the entire extent of the Russian empire a regular system of observations on the daily changes in the state of barometer, thermometer, and hygrometer, on the temperature of the soil, the direction of the wind, and the moisture of the atmosphere. The interest which all the members of the academy took in Humboldt's plan, was increased by the emperor's interest; and, if it is taken into account that the Russian empire presents a surface larger than the whole visible

surface of the moon, it will be comprehended what important laws of terrestrial organization can be deduced and revealed by contemporary and comparative observations over such a large field. The Russian government at once acknowledged the importance of these plans, and instituted a physical observatory in St. Petersburg, whose task it was to choose the other observatory stations, to compare and adjust the instruments with which the experiments were to be made,—accurately to determine the astronomical position of the stations selected, to superintend and direct the magnetic and meteorologic researches, to arrange the collected results, to calculate them, and to publish the mean results.

The special mineralogic geognostic experiences and inquiries which had resulted from the Asiatic expedition, were confided to the care of Gustav Rose, one of Humboldt's companions. His work appeared in two volumes in the years 1837 and 1842, as a portion of the collective work,* under the special title "Mineralogical geognostic division and historical account of the journey," and Humboldt had given the compiler a large number of notes and observations from his own diary. But before the third part of the collective work appeared, which was to contain the botanic and zoological results arranged by Ehrenberg, and the investigation into the geographic distribution of plants and animals, Humboldt published another new work under the title: "Asie centrale, recherches sur les chaines des montagnes et la climatologie comparée," (Paris, 1843, in three volumes,) which was soon afterwards enlarged and translated into German, by W. Mahlmann.

This work is the real result of the studies, which Humboldt had for many years devoted to this subject. We have mentioned in former chapters, when he first

* The collective title runs thus: "Expedition to the Ural, the Altai, and the Caspian sea, by command of his majesty the Emperor of Russia, in the year 1820, made by Alexander von Humboldt, G. Ehrenberg, and Gustav Rose."

planned a journey to Asia, and if possible, to East India, with what perseverance and trouble he had prepared himself for a journey to the little-known districts of Central Asia. He was then excited to it by his favourite project of travelling to these unknown territories, over Kashgar or Persia. He freely acknowledges, that this has always been a favourite idea of his, and if he speaks of it now, he declares that he regrets nothing so much in his old age, than that he did not then carry out that cherished project. But the preparatory studies for that plan were not lost to science, for they gush forth amply in this work on Central Asia, and give it a serious characteristic of profoundness and great erudition. After the publication of the Asiatic fragments, in 1831, twelve years elapsed, during which he collected a multitude of fresh materials, especially the communications received from his correspondents in Russia, entrusted with the comparative observations, and from the physical observatory of St. Petersburg. The entire surface of the Russian territories had been lying open before his mental perceptions for twelve years, and it is, therefore, very natural that Humboldt preferred, instead of preparing the required second edition of his Asiatic fragments, to write an entirely new work, which might include the considerably increased facts of his geological experience. Only he was able to conceive, and to realize such a work, for, whatever he, as a single individual, was not able to master, was gladly prepared for him on all sides by the disinterested and voluntary assistance of the most profound scholars and oriental linguists of the Chinese, Arabic, and old Indian Zend dialects, and by celebrated naturalists, such as Klaproth,* Stanislaus Julien,† and Eugéne Burnouf.‡

* Klaproth prepared new notes from Chinese sources.

† Member of the Institute of France. He gave special physical and orographical (of mountains) explanations; and Humboldt publicly declares that he feels himself honoured by his friendship.

‡ He made ethnographical and geological investigations on passages in the Zend books for Humboldt's work, and Humboldt himself calls his labours most surprising.

Geography gained new sources of information. The knowledge of the direction, the construction and the geological peculiarities of the great Asiatic mountain ridges, acquired an extraordinary degree of profundity and accuracy, by Humboldt's method of the constant comparison of all scientific elements; and the regular taking into account similar and opposite experimental results in Asia, America, and Europe, created a climatology, which was founded on the most important revelations of all the natural sciences. Only the adept in the science of nature can entirely perceive and comprehend Humboldt's greatness; the uninitiated can only admire the mysterious extent of his labours, and Mahlmann, the German translator of "Central Asia," who had given a sketch of Humboldt's labours several years before in the *Illustrirte Zeitung*, concludes his preface to the German edition of the work, with the following enthusiastic words:

"If Alexander von Humboldt be the chief founder and representative of that condition, to which research has developed itself in our century, striving after universality in everything; and, if for that reason alone, each of his works is a great inheritance for future generations, we are more than ever impressed with admiration in his investigations on the formation of the earth, how the most profound study of countless sources of knowledge were united in Humboldt, with the most comprehensive acquirements in all branches of human knowledge. We see with increased interest, with what talent Humboldt recognises the mutual interconnexion of all branches of natural sciences, and the eternal influence of nature, on the life and destinies of nations, and with what unusual simplicity he can represent it. With increasing delight we watch him in the art which few possess, of collecting, regulating, and sifting a chaos of facts, and then of combining them to universal ideas and reflections in which individual facts meet as the rays in a focus. Then we perceive with astonishment, how, by the union of these rays, the

internal connexion of apparently foreign phenomena, is clearly understood, and how Humboldt has gradually introduced us to those great natural laws which rule in the apparently anomalous whole, and which had been hitherto concealed from the eye of the student." Humboldt's travels are not written for the great public, and therefore they have all been modified by other writers for the popular taste; but these modifications even are only intelligible to the more intellectual reader, and can only be appreciated by him. Every man, even the illiterate follower of material interests, knows the name of Humboldt, but his works are only read by the thinkers, for it is not Humboldt's manner to describe his personal adventures on his travels, and afford that amusement, which the travels and voyages of many others are intended to awaken. His descriptions are all distinguished for their real scientific character, which requires intelligence, education, and serious reflection in the reader.

The results of the Asiatic journey, which Humboldt has given in his work on Central Asia, are very various, and cannot yet be combined under one common head. The most important new investigations which have here led to further inquiries, are the treatise on the mean altitude of the great continent of the earth, on the table-lands of the interior of Asia, on the mountain system of Knesslun, on the depression of the Caspian Sea, and its environs, below the level of the ocean; also historio-geographical investigations into the former course of the River Oxus, and communications on the boundary of perpetual snow. Besides this, the work contains plates, which give the mean temperature of more than three hundred places, and besides the voluminous geognostic revelations of the Ural, the volcanos, the beds of gold, and on the produce of the gold washings in the Ural districts, and in Siberia, on the diamonds in the mountains, there are explanatory essays by Stanislaus [illegible], on Chinese historical sources, additions by [illegible]roth, on volcanos, notes by Valenciennes, on the sea-dogs of the Caspian Sea, &c.

The work abounds in important results, and includes a chart of Central Asia, drawn by Humboldt himself, which is prepared entirely according to the latest astronomic and altitude measurements. The calculation of the astronomical observations made for this purpose, in Siberia, was the last work of Humboldt's constant fellow-worker, Oltmann, who died soon after the completion of this task.

CHAPTER IX.

ALTERNATE RESIDENCE IN BERLIN AND PARIS—DIPLOMATIC EMBASSY —DEATH OF WILLIAM VON HUMBOLDT—LITERARY ACTIVITY— HUMBOLDT'S RELATION TO KING FREDERIC WILLIAM IV.—DISTINCTIONS—RETROSPECT.

AFTER Humboldt's return to Berlin on the 28th of December, 1829, he commenced the great literary labours on the stupendous material which was to be prepared for publication by himself and fellow-travellers, as the result of their voyage. Although Humboldt had fixed his residence in Berlin, the publication of his work on Asia soon necessitated a longer stay in Paris; for in that city lived friends and scholars, whose personal assistance was required for his great literary purposes. So he spent his time alternately in Paris and in Berlin. In 1830, the peace of Europe was terribly shaken by the French revolution. The people demanded new arrangements; the sense for political life was aroused; the Polish nation demanded their freedom; and Germany in general, but Prussia in particular, was in a critical state.

Alexander von Humboldt had never interested himself in the details of politics; but he who enjoyed the personal affection and complete confidence of the king,—who, in the sphere of sciences, belonged to two nations—for the French ranked his works among the highest of their national literature, and claimed him for the honour of their country; and Germany, to which he belonged by birth, did the same—he seemed

in the critical moment, when France and Prussia had been momentarily disturbed in their friendly relations, as the most fitting mediator between two nations who were both proud of him. Therefore, King Frederick William III. sent Humboldt to Paris, in September, 1830, with the diplomatic mission to acknowledge King Louis Philippe, and the new dynasty; and in February, 1831, he was again sent thither on a diplomatic mission, while his brother William was also at this time summoned from his private position, and by the decoration of the order of the Black Eagle, and admission into the Council of State, received—as Alexander said a few days before his departure for Paris (on the 26th of September, 1830)—a kind of compensation for the former slights of the Chancellor Hardenberg. It is very probable that Alexander von Humboldt availed himself of his confidential position with the king, to speak of his brother William to him, and to bring about this restitution.

Henceforward the brothers lived quite for each other, and their social, as well as their intellectual joys, flowed from the common fount of love. The exchange of their ideas was now a personal, direct one, and the former long separations were compensated by the most intimate interchange of knowledge and of feelings. We quote what the biographer of William von Humboldt (G Schlesier) says on this subject: "William now had his brother Alexander constantly with him; and how much had they not to speak who had been so long separated, and who, for reasons which may be easily imagined, could not even express their affection in writing. The letters they interchanged were rare and barren, like a landscape without water or vegetation; for, as is generally the case, they did not even communicate to each other what they might unhesitatingly have written. What must have been William's joy at the return of his brother, and when he saw him, the younger and stronger one, advance gloriously on his career. We know how their studies had always been in common

from their childhood upwards, and how each affectionately watched the other's course, and how in their totally different pursuits, those fields of intellectual enjoyment, on which they could both meet, were never overlooked. When the one brother was deep in the laws of intellectual and historical life, or among the remains of extinct nations and languages, and seemed chained to one spot in his studies; while the other examined the physical world in its enlarged sphere; both could meet again on the subject of the nature of the human mind, of the races of man, and the diversity of languages. But even when their respective spheres were farthest asunder, their perfectly harmonious education, their disposition and character, and even the manner and eloquence of their style, reveal their common origin, and the intimate connexion of their whole being. It can therefore not surprise us that these brothers are honoured by the title of 'the German Dioscuri.'"

Alexander von Humboldt must also have been in Weimar in 1831, and have visited Goethe, for we find in a letter from Goethe to William von Humboldt, dated the 1st December, 1831, the passage: "I owe some hours of a frank, friendly conversation to your brother, for whom I can find no expressive title. For although his views of accepting and operating on geological objects is quite impossible for my cerebral organs, I have seen with real interest and admiration how that of which I cannot convince myself, is with him clearly deduced, and enters into combination with the stupendous mass of his knowledge, where it is then digested by his most estimable character."

In 1830, already William von Humboldt regarded the physical strength of his younger brother as a fortunate circumstance, to which he attached the hope that he, as the survivor, would arrange and superintend his literary inheritance, as he could not imagine a fitter person. This hope was soon to be realized. Fate granted but a few years of close union to the

two brothers, which union had also brought Alexander into nearer social intercourse with the friends of his brother,—such as Goethe, Wolff, Frau von Varnhagen, Kareff, Colta, Gentz, &c. Many of William's friends had already been called from this life, when he was seized with debility in the winter 1834-5,—among them Niebuhr and Stein in 1831, Goethe and Gentz in 1832, Hegel, and Schleiermacher. He was living at Tegel at the time, with his eldest daughter Caroline, the lady Adelheid von Hedemann, who had, with her husband, been living some years with her father and Frau von Bülow, while Alexander was in Berlin, anxiously awaiting news of his brother's health, as his nervousness, his stooping, and the trembling of his whole body, had alarmed him. Dieffenbach and Rust were attending him, but a cold which he took on the birth-day of his departed wife, over her grave, hastened his death; he died on the 8th April, 1835, in Alexander's arms. During the last illness of his beloved brother, Alexander wrote a letter to Varnhagen,* which expresses his fraternal grief; and immediately after his death, he wrote from Tegel to Arago, in Paris, which letter as evidently shows what the surviving brother

* The letter is as follows:—

"Berlin, 6 o'clock a.m., 5th April, 1835.

"You, my dear Varnhagen, who do not fear pain, but consider it reflectively in the depth of the feelings, you must receive a few words of love which the two brothers feel for you in this mournful time. The dissolution has not taken place yet. I left him at eleven o'clock last night, and hasten hither again now. Yesterday was a less painful day: he was in a half soporific condition, had much and not very restless sleep; and, at each awaking, words of love and consolation, and the clearness of his great intellect, which comprehends everything, and examines its own condition. His voice was very weak, hoarse, and sharp, like a child's, therefore the physician applied leeches to the larynx. He is perfectly conscious. 'Think often of me,' he said, the day before yesterday, 'but always cheerfully. I have been very happy; to-day also was a happy day for me, for love is the greatest happiness. I shall soon be with your mother, and comprehend the laws of the higher world.' I have no hope. I did not think my old eyes could shed so many tears. It has lasted now eight days.

"A. v. Humboldt."

had lost.* Alexander has since fulfilled the noble duty towards the sacred memory of his brother by superintending his literary remains, and by publishing them regularly.

Alexander soon again devoted himself exclusively to science, and a year rarely elapsed in which he did not cast a fertile glance into the kingdoms of nature, or did not discover some new treasure for science. Of his brother's manuscripts, he made his extensive researches on the Kawi-language into a subject for his own labours, for he had himself collected the materials for it, and its publication was therefore especially interesting for him. He lived on, working, and producing labours even in others, who often took a thought or single fact from Humboldt, developed it, and were led by it to important results. His Asiatic works occupied the principal part of his time, and necessitated an extensive correspondence with his friends in Russia and Paris; and besides this he had constantly to superintend and direct the labours which others devoted to his purposes.

Besides this, he was employed in the continuation of formerly-commenced works, and with his "Critical Investigations."† In 1838 he published a politico-economical essay on the variations in the supply of

* One passage of this letter says: "I am in the deepest grief, and at such times one thinks of those dearest to us. I feel a little relieved while writing to you. . . . I remain quite desolate. I hope that I shall have the pleasure of being with you this year. . ."

† These critical investigations on the historical development of a geographical knowledge of the new world, and the progress of nautical astronomy in the fifteenth and sixteenth century, appeared originally in French, and were published in German, by J. L. Ideler. They contain the most important results of Humboldt's leisure hours during thirty years, and are the foundations of a history of Columbus, which he once intended to write.

The work is in four divisions: the first treats of the causes which prepared and led to the discovery of the new world—the second, of several facts more nearly relating to Christopher Columbus, and to Amerigo Vespucci, and of the dates of several geographic discoveries—the third, of the first maps of the new world, and of the time when the name America was first commonly used—and the fourth, of the progress of nautical astronomy and chart drawing in the fifteenth and sixteenth centuries.

gold, in Cotta's quarterly journal, which was an application of his researches in the Ural mountains. In 1839 and 1840 he drew a new hypsometric chart of the mountain-chains and volcanos of Central Asia, which is sketched and completed with wonderful accuracy, and is appended to the revised edition of his work on Asia. The publication of this work was delayed, because Humboldt made several short journeys, especially to Paris and to other German and foreign capitals, but partly because he was disturbed from his private affairs by the death of Frederic William III., an event which touched him very nearly.

His position towards the highest person in the realm remained the same after the ascension of Frederic William IV.; for the latter had always felt the personal intercourse with Humboldt as an intellectual and social necessity. As crown-prince, he had also been a friend and admirer of William von Humboldt, to whom he felt attached by his artistic tastes and by his interest in æsthetic and learned education, although the two were entirely at variance in their political and religious views. Alexander von Humboldt soon became the new king's confidential companion and scientific adviser, and has since always been in the immediate vicinity of the king, with whom he has lived in Berlin, Potsdam, Sansouci, &c., and whom he has, in his advanced age, accompanied on longer and shorter journeys. Thus the Prussian court honours itself with one of the brightest stars of the highest intellect in the person of Humboldt, although it cannot be denied that his relation to the court steals many hours from his valuable life—which should be strictly husbanded—from science, and especially from the completion of his great work.

Down to the present time, Humboldt has devoted much of his time to astronomical-mathematic geography, which science never made such speedy progress until Humboldt's day. By his acute

observations in America he has opened an entirely new sphere for this science, and has constantly worked himself, and urged others to labour in its interests. This made him more and more intimate with the geography of America, and with the history of nautical instruments, in the fifteenth and sixteenth centuries. The fifteenth century may be said to have doubled the works of creation by the revelation of a new world, and has introduced many new objects into the old world, which have gradually tended to change many relations and views of Europe. This era has a peculiar interest for Humboldt, because the human race made an intellectual and material progress by the discovery of America; new fields for commerce and insight into a new world were opened. None other but Humboldt was so fitted to continue the history of those great and bold exploring expeditions. Had *he* not also gone to sea from Spain as the second discoverer of America, and had he not stood on the same spot where Columbus had landed and taken possession of the new continent? And he who, forty years before, had intended to write a history of America, and had even commenced it, though he subsequently abandoned the plan—who had therefore acquired the special knowledge of the territorial and national condition, and had examined with great partiality and eagerness the original accounts of America in the European libraries—he was especially qualified to give a sketch of the cosmographic views of the fifteenth century, and the astronomic systems of that period. He established the most important results in these critical investigations, and proved them by numerous new facts referring to the history of the world, the most ancient histories of man; and adduced the intimate connexion—in spite of the barbarism of the middle ages—between the views and opinions at the close of the fifteenth century, and those of the times of Aristotle, Eratosthenes, and Strabo; and imparted his proofs with surprising lucidity, basing them on the gradual and universal progress of the human

mind. Thus he attributed the great ruling thoughts of life and history to the grand discovery of the fifteenth century. He also constituted himself the scientific defender of his predecessor, Columbus, whose merits his contemporaries and successors notoriously endeavoured to traduce. Humboldt's critical investigations have established beyond a doubt that Columbus had commenced his great work of discovery at the suggestions of his own mind and opinions; that he made use of traditions and suppositions of former ages till they became his independent opinion, and the spring to bold adventure and unfettered action.

In the year 1840, Humboldt published Academic Dissertations on his ascent of the Chimborazo, and on the mean elevation of the continent; also a critical memoir on some important positions in Guiana; besides this he re-commenced the work which had been interrupted in 1828—his universal physical description of the world, under the title, "KOSMOS," which he now continued on a more extended plan, and was also superintending the publication of his brother's posthumous works, being at the same time an active member of the academic committee for the publication of the works of Frederic the Great. In January, 1842, the king summoned him from these labours by honouring him with the command to accompany the court to England, for the christening of the Prince of Wales. Although Humboldt was honoured by this distinction, and by the respect paid him by the English court, he also did honour to the king's journey by his personality, and the intelligence of England worshipped him wherever he showed himself.

In May of the year 1842, Humboldt received another royal favour on the 102nd anniversary of the ascension of Frederic the Great. About this time Frederic William IV. instituted a peace class of the order of Merit, founded by Frederic the Great only as a military order,* which was henceforward to decorate

* Under Frederic the Great, only five non-military persons were admitted to the order, namely, Voltaire, Maupertius, Algarotti, the

the greatest scholars and artists of the world as a symbol of royal favour. Thirty knights were entitled to a vote to choose such individuals among the German nation whom they considered as meriting this distinction, and it was also decreed that the number should be limited to thirty German scholars and artists. Besides these thirty Germans the order could be conferred on distinguished foreigners. Alexander von Humboldt, as the greatest living scholar who united the attainments of a whole academy in himself, was appointed grand chancellor of the order.

We have not, in this biographical sketch, spoken much of the personal decorations conferred on Humboldt, as every reader would think it self-understood that a man who had attained the highest summit of scientific fame, and who stood in the most intimate relation to the princes of all countries, would not be wanting in exterior tokens of favour and merit. And he not only received numerous honourable distinctions from princes and from learned associations, but he received them very early in life. We have mentioned his elevation to a Prussian acting privy councillor, with the title "excellency," and need only add that not only all the great academies of science and art, all the learned societies of the world, considered it an honour to have Humboldt as member, but that all the princes of all countries testified their esteem for him, and their consideration for science, by conferring their highest honours upon him. But these exterior forms can add nothing to Humboldt's greatness, for the glory of his mind and his fame outshines all the stars of merit, which are indeed very rarely seen on his breast.

Humboldt now lives wherever his royal friend lives. There are apartments for him in Berlin, Potsdam, in

minister Von Marschall, and a councillor Eckwricht in Silesia. After 1815, it was scarcely ever conferred by Frederic William III., because there is no opportunity for military distinctions in peace; and the last member on whom it was conferred was the Archduke Frederic of Austria, for his exploits before Acre, 1841.

all the royal palaces, and not a day passes that he does not see the king. In spite of his eighty-one years he works unweariedly in those hours which are not occupied by the court; he is active and punctual in his immense correspondence, and answers every letter of the humblest scholar with the most amiable affability. The inhabitants of Berlin and Potsdam all know him personally, and show him as much honour as they show the king. With a slow but firm step, a thoughtful head, rather bent forward, whose features are benevolent with a dignified expression of noble calmness, either looking down, or politely responding to the greetings of the passers by with kindness, and without pride; in a simple dress, frequently holding a pamphlet in his hand, resting on his back, so he wanders frequently through the streets of Berlin and Potsdam, alone and unostentatiously, a noble picture of a blade of wheat bending beneath the weight of its numerous rich golden ears. Wherever he appears he is received by tokens of universal esteem, the passers-by timidly step aside for fear of disturbing him in his thoughts; even the working man looks respectfully after him, and says to his neighbour, "there goes Humboldt." And whoever has had the happiness of conversing with him, never forgets the force of his lucid, simple, natural, and unaffected conversation, for in everything he says, depth and learning, clearness and unbounded knowledge, are revealed without any of the pride of learning, the stiff pedantry and preciseness of many German men of science. Humboldt has evidently been educated in the highest society; his manner is dignified, open, unaffected, and frank; he has lived with all nations, and adopted and united in himself the advantages of all.

With the name Humboldt, a whole world seems to rise before the mind's eye. We involuntarily see him standing on the highest points of the Cordilleras or the Altai, and looking down into the realms of nature, gazing into the depths of the ocean and into the boundless expanse of heaven like an inspired prophet.

And in his activity he seems like a sun of science, which sheds its rays over the whole earth, and excites, fertilises, and inspires science everywhere. He is in constant correspondence and zealous communication with all ministries which take any interest for the advancement of science, and with all learned academies. The fortunate accident of his birth, as a son of a wealthy and aristocratic family, his influential position at the court of an intelligent king, are very important means in his power, for every government is ready to serve him when it would perhaps have scarcely listened to a man of mind born in a humbler sphere and a less favourable position. None but Humboldt could have encompassed the earth with a circle of magnetic observatories such as were erected at his instance. To assist him in his investigations on the deviations of the magnet was a point of honour for the governments, and his wish sufficed to induce them to raise a series of stations for magnetic observations over the entire middle of the old continent from Pekin to Lissabon, which have been increased and extended since 1840 over the southern hemisphere, nearly to the extreme limits of the southern polar circle.

If we now glance over the life of this distinguished man, evidently elected by Providence as the especial medium of scientific revelation, then his intellectual individuality, as we sketched it in the introduction to this biography, will be more plainly before the reader. We will endeavour again to paint the portrait in its universal features. He was pre-eminent in so many branches of science for infusing intelligibility and lucidity into them, that one scarcely knows where to commence. But it may be said of him in general that he was the first to arrange and sift the chaos of isolated experiences of the former and of contemporary ages, to place everything in its proper department, to make it a comprehensible member of collective nature. The anomalous was made conformable to rules by his critical penetration, isolated facts

were incorporated into their relative groups, and the entire system of nature in its great natural laws was revealed to the inquiring human mind. Thus he became, as we have shown, the founder of comparative geography; he was the founder of a new theory of geology, and in a work prepared by him and his friend Leopold von Buch, he referred to the influence of the volcanic agency on the formation and continual alterations of the earth, rejecting his teacher (Werner's) theory of Neptunismus,* and acquiring new facts on volcanic agency; he was the founder of botanical geography, a new theory on the laws of the distribution of plants; he was the discoverer of a new world with new phenomena, new manners, new languages, and traditional remains of an entirely unimagined antiquity; he was the reformer and teacher of a new chartography for accurate delineation and supervisual description of large territories; he was the representative of a new mode of treating natural science in general, which he created himself, and which has been developed by the tendencies of the present age. This system, striving for universality, studies the connexion of the various fields of nature in its most secret recesses and with pure experience, without speculative deduction or explanation, only seeks facts, arranges, combines, and explores the intimate connexion of cause and effect as a means for the comprehension of natural laws. He was the founder of the new school which combines physical science with the history of humanity, and which has been the most prolific in unexpected results. This mathematically "EXACT" method was originated by Humboldt; it has been adopted by the greatest scholars, but it has also unfortunately led to the most trivial empiricism with those who only know Humboldt's method, but are incapable of imitating his mental aptitude for combination and his intuitive power.

* Explanation of the formation of the world by the effects and deposits of the waters of the earth.

And if we consider his style, the manner and form of his literary descriptions, the artistic side of the author, we shall here again find the truth of the well-known proverb: "*le style c'est l'homme.*"

Two nations, the German and the French, claim Humboldt as one of their classical authors, for he is equally great in the simple elegance and fluency of literary description in both languages. Although he often treats of subjects dry in themselves, and which, by a rigid enumeration of self-describing facts, seem little adapted for an elegant diction, his writings are all distinguished by a style which is as easy, fluent, and lucid in its simplicity and unaffected elegance, as it is lively, eloquent, and elevated whenever the subject permits it. His scientific communications bear the characteristic of clearness, and of being founded on ample proofs; his descriptions of nature, without being overburdened with words, seem like living landscapes painted with accurate fidelity, and their interest and charm are increased by being interspersed with genial interpretations of nature and its grand phenomena, while the narrative portion of his travelling experience is often given with a witty, cheerful, even humorous, freshness of conception and of judgment, and his simple sketches of scenes from natural or national life often attain to poetical elevation.

He has peculiarly the talent of describing the splendour of natural scenery by undeviating fidelity and absence of all merely rhetorical ornamentation, whether these descriptions paint the calm or the stormy ocean, the savannas of Central America, the giant forests of the tropics, the deserts and precipices of the Peruvian and Mexican mountains, or the unvegetating snow summits and craters of volcanos. Wherever he describes a single object, any phenomenon or discovery, he always bears in mind its relation to nature in general, short and concisely, without degenerating into poetical exaggeration; he can keep alive our admiration for the grandness of

nature, whether he describes a majestic or a terrible landscape, a mineral, a plant, or an organic law. By this unadulterated faithfulness of description, this simple painting of subjects just as nature reveals them, and as the mind and heart are normally moved by them without intermixture of morbid sentimentality, or subjective peculiarities—by this, Humboldt enchains the reader, and gives him such a conception of the tropics, that he forgets whether he has seen these scenes himself, or has only made their acquaintance through a written delineation.

Humboldt is the representative of pure objectiveness and reflectiveness; like a concave mirror, he reflects all the received rays in the purest light, but having a collective ideal focus in the back-ground.

In his work on the journey to the equinoctial regions, he made use of a species of description which, if not quite new, was employed with very happy effect by him, and perfected to a high degree. This method, which has since been frequently adopted, has the peculiarity that he frequently pauses in the narration of his adventures and journeys to make observations, and give explanations on what has passed, and prepare the reader for the better comprehension of what is to follow by communicating general facts, and by remarks on the general aspect of the coming events on these stations in the journey. By this method of description such travels, especially when they refer to the personal adventures and accidents of journey, lose that uniformity, subjectiveness, and monotony which is but little removed from tediousness. Humboldt never obtrudes his individuality; his aim is always to give a scientific character to the narration in which he plays a prominent part, and it must be especially mentioned that he always rigidly distinguishes and explains what is the result of his own observation, and what he has adapted from other sources, or made use of as auxiliary explanations. This characteristic is quite in unison with his modesty and scientific consciousness, which makes him sift and arrange his facts

and his observations, in order to classify them as strictly as he respects the scientific acquirements of others, and use them only as an acknowledged loan when this mutual exchange promises any advantage to the interests of science objectively. His reader will perceive in every page of his works that when Humboldt writes, such a mass of scientific material crowds upon his happy memory, that in thinking, he compares, quotes, corrects, confirms, or contradicts. The entire field of science lies open before his mind when he perhaps only intends to communicate one single fact of his experience. Hence it comes that his writings, especially those that are purely scientific and descriptive, have, besides the original by himself, a rich appendix of notes, quotations, comparisons, and references, in all sciences and from all ages, which sometimes surpass the purely descriptive text in force, and adorn it like pearls on the string which connects them. These notes especially force us to admire the unexampled universality and profundity of his erudition and his power of memory.

Humboldt displayed much tact in the composition of his great works. He wrote them originally in the French language, the universally-understood medium of the civilized world, and thus made it possible that they should be available to all nations. Thus the great effect of his writings on the majority of intelligent readers was at once an universal one, equally effectual at the same time with all nations in producing a speedy development of the universally-awakening sense for natural science and comparative studies, and by arousing and increasing an interest for Humboldt's system of scientific observation. His writings have also been frequently translated into other languages—by Wimmer into German, by Williams and Macgillivray into English. Some works were translated into German under Humboldt's superintendence, as, for example, his Asiatic voyage by Mahlmann, and some were popularised and published by extracts. During the last few years he has com-

menced to publish a work great in its plans but not yet completed, a testament, as it were, of his scientific labours of sixty years, a heritage for the world to which we will call especial attention in another chapter.

CHAPTER X.

KOSMOS, AS THE EPITOME OF HUMBOLDT'S SCIENTIFIC LIFE.

In speaking of the lectures on physical geography given by Humboldt in the winter of 1827-28, in the Lecture-room of the University, and in the Large-hall of the Singing Academy of Berlin, we mentioned that he had the intention of publishing these renowned lectures in a work called "Kosmos," but that other occurrences forced him to delay its revision and publication. He considered these lectures, delivered before a large miscellaneously educated public, as an easy conclusive means of proving the good or imperfect connexion of single portions of his theories, and, therefore, he had before coming to Berlin given similar lectures in Paris in the French language. He laid down in unstudied addresses, and without written notes, his conception of science; and how anxious the public were to retain the fugitive words, is evident from the fact that of his capable hearers several took down his lectures, and several prepared and published them by means of notes and an excellent memory. Humboldt did not write down what he had then lectured until 1843 and 1844, but how could he have written the same when in the intervening time the treasures of observation and experience had so considerably increased, and opinions and theories had been developed by more mature consideration? But in order to give unity, spirit, and life to his subsequent descriptions, he started from those lectures and the era of science therein

represented, and developed them from his former themes, on the footing of continual progress. This is the exterior history of that great work, which has appeared in modern times under the title "Kosmos."

But this work has also an inner history which reflects the mental development of Humboldt's life. We have called this work a testament, a heritage to the world, and Humboldt himself says of it that he offers a work to the German public in the evening of his active life, the plan for which has been present to his soul in faint outline for nearly half a century.

He recognised the importance of his scientific testament, for he knew that he must conclude the results of his life. He often deemed the undertaking impracticable, and yet, urged by the collective fruits of his life, and by the feeling that he owed the world a general resumé of his researches, extended over a period of fifty years, he always returned to this work of making the treasures of his eminent mind the common property of his German fatherland, and to delegate it to them as a valuable inheritance. This feeling is expressed by the fact that he wrote the work in the German language. The great purpose of his life was to comprehend all matter in its general connexion and entire nature as a unity, moved and impregnated by inner powers. By the investigation of a single fact in natural science, the knowledge of other single facts were revealed to him, for the different domains of science fertilized each other; he explained the complicated causes of the varied forms of existence, and traced them to the prevailing laws of the unity of nature.

This great aim of his life was especially advanced by the happiest social circumstances which are rarely offered to a scientific traveller; for he not only found the opportunity of seeing coast lands, like most circumnavigators, but also of penetrating far into interior plains of two world-quarters, where he investigated the most prominent contrasts of nature,—the

South American tropics and the steppes of Northern Asia,—and was thereby led to comparisons and general observations, and thus became qualified to conceive heaven and earth in its entirety as a physical unity.

His immense scientific attainments were at the service of all men of science. Humboldt not only imparted them freely, but arranged them comprehensively in his works. But the summary of his knowledge, the fruit of his life, he dedicated to his fatherland, and for this purpose he started from the point where he had first been a public instructor of the people, from his lectures in Berlin, which commenced what Kosmos was intended to complete. But the lectures and Kosmos have nothing in common except the order of subjects; for since 1827 science has necessarily taken another form in consequence of the progressive explanation of natural phenomena and physical laws, in consequence of the increasing perfection of experimental instruments and the consequent enlargement of the perceptive limits; the mysterious had been explained, the impenetrable had been cleared, and the mind itself had risen to a higher standard by the simultaneous action of new views and experiences. Humboldt felt, more than any one, the great difficulty of producing a work which might be a faithful, enduringly correct picture of an eternally progressive world; for the higher the student attains in the progress of the human mind, the more the horizon extends with new fields for observation. Works on natural science become old in time and are forgotten; but Humboldt, inspired by the high dignity of natural science, and by an ardent love for it, was not discouraged when he was reminded of a future perfection of human knowledge, for he knew that he had been instrumental in raising the firm, indestructible foundations for many of its most important branches. And if even what now appears as a single phenomenon be in future classified under a general law, if new powers are disco-

vered or explained, if apparently simple matter be increased in number or recognised as being compound, Humboldt's researches will nevertheless be important to the most remote ages, for they show us nature in its animation, and point to the eternally immutable and regular amid physical mutability.

The order in which the lectures were given is adhered to in Kosmos. We have stated that the course consisted of sixty-one free addresses, which were subdivided as follows :—

Five lectures treated of the nature and limits of physical geography, and included a general sketch of nature.

Three were devoted to a history of the science of the world.

Two to inducements to a study of natural science.

Sixteen to the Heavens.

Five to the form, density, latent heat, and magnetic power of the earth, and to the polar light.

Four were on the nature of the firm earth crust, on hot springs, earthquakes, and volcanos.

Two on mountains, and the type of their formation.

Two on the form of the earth's surface, on the connexion of the continents, and the elevation of the soil over ravines.

Three on the sea as a globular fluid surrounding the earth.

Ten on the atmosphere as an elastic fluid surrounding the earth, and on the distribution of heat.

One on the geographic distribution of organized matter in general.

Three on the geography of plants.

Three on the geography of animals.

Two on the races of man.

This will serve as a review of the general contents of Kosmos. A world is revealed to our senses and our intelligence in this work of Humboldt; the entire world as a scientific, strictly objective, but at the same time truly animated picture of infinite variety

and sublimest unity, of constant motion, and of the immutable repose of eternal laws. He first brings us to the right point of view for the contemplation of this great picture, by explaining the variety of its pleasures,—he facilitates the comprehension of natural laws by his experience, and then unveils the great picture in perspective, commencing with the most distant nebulæ and revolving stars, and proceeding gradually to the earth, its geography, its plants, its animals, and its human inhabitants. Herein he shows the intimate connexion of general truths and special developments, with that geniality of scientific treatment in the choice of matter, and in the form and style of composition, which is so peculiarly his own; and then follow the incentives to natural studies, among which he enumerates, especially, lively descriptions of natural scenery, landscape painting, intercourse with plants, and their taste-elevating cultivation in conservatories.

The great truths explained in Kosmos are a legacy to the German nation, and therefore this biographical monument is the most fitting place for explaining the basis of this scientific testament to the people in intelligible language.

Nature, as Humboldt represents it, is as capable of affording the noblest pleasures as it is of inciting to the highest intellectual development, and to an insight into the profounder duties of humanity. In any intercourse with nature, as a well-understood and explained world of phenomena, where every form and motion are referred to a well-considered law, man must become nobler and more self-conscious; but it is not indifferent by what means man attains to a higher enjoyment of nature. Humboldt says this in the introduction to Kosmos, and reveals the individuality of his own nature. He thinks that the lowest kind of appreciation of nature is independent of an insight into the effects of its powers, but almost independent likewise of the peculiar characteristics of the surrounding scenery. He says:—

"Where uniform social plants cover the plain, and the eye rests on the boundless distance, where the ocean's waves playfully wash the shores and thread their way through elms or sea-weed, the feeling for free nature penetrates us everywhere, and the inward presentiment of its existence by eternal laws."

Whoever has felt that a secret power exists in these emotions, which refreshes, exhilarates, and strengthens the wearied spirit, or soothes the afflicted heart, and the storm of passion, will admire Humboldt's clearness of perception, before which nature revealed herself to him. The solemn and serious feeling which inspires us at such moments rests on the almost unconscious sense of a higher law and natural legality; it is universality which stands before our own limitation from which we would escape; it is an enjoyment of nature accorded to all men, intelligent and ignorant, on all portions of the world filled with animal and vegetable life.

But Humboldt perceives another higher enjoyment, likewise appreciated by the feelings, in the circumstance that man is moved not only by a communion with nature, but by the special character of a locality. He says: "Such impressions are more vivid and more decided, and therefore fitted for peculiar emotions. Sometimes our feelings are excited by the grandeur of nature in the wild struggle of conflicting elements, or we are impressed by the desolation of immeasurable prairies and steppes, pictures of the immutable and rigid; sometimes we are enchanted by a more pleasing image, the sight of a cultivated field, the first settlement of man, surrounded by rocks on the brink of the bubbling mountain rivulet."

These two phases of an enjoyment of nature, especially the latter individual one, where the positive circle of ideas and feelings which are excited by nature prove its force and stability, are felt by Humboldt in a truly poetic manner, as we shall often find in his works. Wherever he indulges in recollections, his emotions wander back to the impressions of nature—

he thinks of the ocean in mild tropical nights, when the calm starlight, not sparkling in those regions, pours over its expanse of waves; he thinks of the wooded vales of the Cordilleras, where strong palm trees, like pillars, break through the dark foliage; he thinks of the Peak of Teneriffe, where layers of clouds separate the cone from the lower earth, and a sudden rent in the clouds opens a view for the spectator on high over the vine-covered hills of Orotava and the gardens on the coast. These great scenes of nature exercise their influence by the individual character of the landscape, and not by the calm, creative power of still life, for even the terrible, the infinite, and incomprehensible, are a source of enjoyment here. The imagination endeavours creatively to supply what remains veiled from the senses, and we erroneously believe to receive from the material world what our feelings have introduced into it. Humboldt says: "When after a long voyage far from home we for the first time set foot in a tropical country, we rejoice to see on the steep precipices the same rocky formation which we have quitted on European soil, and whose universality seems to prove that the earth crust was formed independently of the exterior influences of the present climatic relations; but this well-known earth is decked with the forms of a foreign flora. Then the wonderfully adaptive power of the human mind reveals itself to the inhabitants of the northern zone, surrounded by unaccustomed plants, by the overpowering grandeur of the tropical organizations, and by an exotic nature. We seem so familiar with all organized matter, that if it even at first seems as if our native landscape, like a native dialect, would seem more familiar and agreeable than this foreign, voluptuous fertility, we are very soon at home in the palm climate of the torrid zone. By the mysterious connexion of all organic matter (and the feeling for the necessity of this connexion is involuntarily latent within us), those exotic forms seem to our phantasy as the ennobled and more elevated forms of the same objects which

surrounded us in youth. Thus obscure feelings, the connexion of material observations, and afterwards the active exercise of reflection, lead us to the knowledge which penetrates through all grades of civilization, that a common, ordained, and therefore eternal unity prevails over all nature."

But another and a higher enjoyment of nature is that where *ideas* are united with the excitement of the feelings,—where the regular and immutable laws of nature are not only felt, but acknowledged by the reasoning power. Humboldt not only did much for the development of this feeling, but has endeavoured to excite men to it, and educate them for it, by his writings. For an appreciation of nature in its regularity is a duty of civilization; it is a human, ennobling enjoyment, for which a want is felt by the increasing education of our age, and needs a greater development. In spite of a generally high intelligence, the grossest ignorance on natural subjects still prevails even in the higher classes, and an appreciation of nature rarely rises above the before-mentioned lower grades of a simple emotion. But in the present age, where all classes strive to enrich their life by a greater abundance of ideas, a better insight into nature cannot fail; and therefore Humboldt's "Kosmos" is important for the German nation, as this work professes to be an educational medium to develop in the people the highest phase of an appreciation of nature—the knowledge of nature in her regularity and legitimacy, besides its individual influence on the feelings.

It is sometimes asserted that nature loses her charms, when we inquire into its secret powers and its constitution, that it loses its mysterious halo and exalted elevation; but, even if the play of imagination is circumscribed, and the charm of the mystery dissolved, if, even, an erring philosopher alleges ignorance of natural laws to be the only source of admiration and elevation; an insight into the intercoherence of all natural objects, when it is attained and practised in Humboldt's manner, and is not merely a crude col-

lection of infinite materials, induces that highest phase of natural enjoyment, worthy of a reflecting man; it enlarges and ennobles mind and heart, it awakes joys of a higher intelligence, and leads to a comprehension of the divine. Every law of nature points to a higher, unrevealed one; with increasing knowledge the sense of infinity increases in the intelligent mind, and Humboldt says, truly, the assertion that natural studies destroy natural pleasures, can only proceed from ignorance, or a sentimental obstruction of the mind. He adds, indeed, that powers, in the real sense of the word, only then work mysteriously in the obscurity of a mysterious force, when their working lies beyond the reach of universally known conditions of nature. The astronomer, who determines the diameter of a planet with the heliometer, or the Iceland crystal, who measures for years the meridian height of the same star, who discovers telescopic comets between crowds of nebulæ, does not, fortunately for the scientific result of his labours, feel his imagination excited any more than the descriptive botanist, while he counts the petals of the calyx, or the stamina of a flower, or investigates the simple or double, the free or the annularly complicated teeth of the seed capsule. But the measuring and discovery of numerical proportions, the careful observation of single parts, prepares for a better knowledge of nature in its entirety, and of the organic laws. The heavens and the fertile covering of earth, must, certainly, seem a more magnificent sight to the natural philosopher, who, like Thomas Young, Arago, and Fresnel, measures the irregular long streams of light, diminishing or increasing in the distance; to the astronomer, who, by means of a space-annihilating telescope, examines the moons of Uranus at the extremity of our solar system, or, like Herschel, South, and Struve, dissolves masses of light into double stars; or, to the initiated eye of the botanist, who recognises the circulation of the sap seen in the Charaplants, in nearly all vegetable cellular forms, and who perceives the unity of

form, that is, the coherence of forms, subdivided into races and families—than to the observer whose sense for nature has not been refined by an insight into its laws.

But, to attain to this, men must make themselves familiar with the universal views of creation; and this is, indeed, becoming an undeniable want for the people, which strives after educational means for the extension of intelligence and learning. Humboldt endeavours to inculcate such general views which help to explain the single and special laws of nature, in this, his legacy to the German people; and, thereby expands the mental life of the nation, by bringing it from its ignorance into connexion with the entire world, by letting it surmise the coherence in the natural phenomena from these general views, and urges on to varied study.

Partly with the view of calling attention to these works of the great philosopher, and of assisting in advancing his purpose in those classes of the people where "Kosmos" still requires a popular interpretation, partly, also, to present, at the close of this biographic sketch, an intellectual portrait of Humboldt, drawn by his own hand, in the general character of the truths acquired by him, by a contemplative observation of natural phenomena; we will now endeavour to give a very brief summary of "Kosmos," which may be generally comprehensible. We address ourselves especially to those of whom Humboldt says: "Whomsoever his position permits, sometimes to rise above the narrow boundaries of civic life, blushing that he has been so long a stranger to nature, and has passed by her without emotion, will find one of the noblest enjoyments which a developed reason can afford to man in the contemplation of the great and unbounded life of nature. The study of natural sciences will awaken faculties in him which have long slumbered; he enters into a closer connexion with the material world, without becoming insensible to the industrial progress and intellectual development of humanity."

We will first follow Humboldt in the general sketch of nature, where he gives us an abstract of natural phenomena. With the word "Kosmos," he includes the All, the universe with its regulations and its laws. Beginning with the most distant nebulæ of the depths of space, he descends gradually to the life of our little earth. Humboldt has studied this universe for half a century, with penetrating thoughtfulness, and clear mind, and he paints faithfully from experience. If we take the universe according to his spirited description, to be filled with a world pervading ether, a vapour-like mass; we see it first condensed into the nebulæ of the sky, and then condensed still more into the comets, but still penetrable by light, until in the planets, all grades of density, from that of antimony to that of honey, water and firwood have been passed through, one planet showing the denser, the other the less solid matter. Humboldt describes these formations in the space filled by ether as balliform matter.

The stranger to astronomic science will be surprised that Humboldt has ventured to determine the locality of our solar system, and of the lens-shaped space filled by the collected stellar bodies in their course round the sun; but this question has long since been solved by astronomy, with measurements of the stars, and observations of their course, and of their variations. It has further been discovered that the self-illuminated suns, falsely called fixed stars, also change their position; that, although our solar system, or, as Humboldt expresses himself, our world-island, only consists of one central body, which we call sun, and of planets, comets, and asteroids, yet other solar systems have two or more of such self-luminous bodies, which has been proved by the discovery of the so-called double stars, and that these several suns in their turn circulate round their common centre, lying in space therefore not indicated by any visible body. Our solar system includes, according to Humboldt, besides the chief planets, moons, countless comets (of which,

three, with almost a planetary formation, do not move out of the planetary course, while the others float far into space), a vaporous, rotatory ring, which seems to be situated between Venus and Mars, to cross the earth's course, and to appear to us in a pyramidical form as the zodiacal light; also a host of asteroids, whose course crosses that of the earth, or approaches very near it, and then, attracted by the earth, fall down as meteors, or star-shoots.

Humboldt has always observed the comets with particular interest, and endeavoured better to comprehend the constitution and qualities of these strange bodies. The old astronomer, Kepler, once said that there were more comets in space than fish in the sea; and according to modern astronomy, the course of scarcely 150 has been computed.

It was to be expected that Humboldt would not pass over in a superficial manner these remarkable bodies, which, with their small bulk, often scarcely $\frac{1}{5000}$th part of the earth, occupy, with their tail, sometimes millions of miles. Their form is varied; sometimes only a cloud of light, a round, brilliant vapour, with a denser centre, sometimes having head, centre, and tail; sometimes changing as if it were engaged in a process of formation. Humboldt endeavours, scientifically, to allay the fear that a comet might some time come into contact with the earth. As these tranquillising reasons, which are founded on calculations of probability, can only influence reflection and reason, and not a desponding mood, or the imagination, science now has destroyed fears which it formerly excited. It is on record that returning comets have approached very near the earth, like the Lexall-Burckhardt comet of 1770, which passed within six moons' distance of the earth, and in 1767 and 1779 passed through the system of the four moons of Jupiter, without causing the least disturbance in their relation to each other, or to Jupiter. But from the scientific facts that Jupiter and Saturn may cause considerable diversity of a comet from its course

by their attractive power, which is commensurate with their bulk; that there are comets returning in a very short time, that Biela's comet traverses the earth's course, and that comets are very different in their individuality; many causes might arise which would make apparently harmless bodies dangerous ones, and which might scientifically confirm the indefinite fears of former centuries.

Our readers will remember that Humboldt observed remarkable showers of shooting stars on his journey to America. In "Kosmos," he gives his accounts of this subject, which he always treated with great minuteness. He calls the star-shoots, and the meteors, and fire-balls of the same class, the smallest of all asteroids, and includes them in the number of bodies revolving round the sun; he considers them, with great apparent probability, as little bodies moving with planetary speed, and revolving round the sun in space according to the laws of universal gravity in conic sections, elliptical and hyperbolical. When these masses meet the earth, in their course round the sun, and attracted by it, become luminous on the verge of our atmosphere, they often let fall a more or less hot, stony matter, covered with a black, lustrous coating. These showers of star-shoots have been observed to be periodical (by Humboldt, 1799, in Cumana, and 1833 and 1834, in North America, besides recurring annually in November, from the 12th to the 14th, and in August, from the 9th to the 14th, and known as November shoots, or St. Laurentius showers), and Humboldt found them brighter, more coloured, leaving a longer, brighter trace, in the tropics, than in the temperate and cold zones, on account of the greater transparency of the hot atmosphere. Humboldt considers the connexion of the meteor stones with the fire-balls as proved; namely, that the former—often seven feet long—fall from the latter, and often strike fifteen feet into the earth, and the intimate resemblance between fire-balls and star-shoots seems to him no longer doubtful, from evident facts. Not so evident is the constitution of these

bodies, their plastic power, their physico-chemical process, whether the parts which form the dense mass of a meteor stone exist separately as vapour, and condense by illumination. What passes in the black cloud of meteors in which it thunders for some moments before the stones fall, whether from the little star-shoots something solid falls, or only a vaporous iron and nickel, containing meteor dust; all this Humboldt has hitherto not been able to discover. The motion, direction, and vicinity of these meteoric phenomena, seem to prove that they come from space into our atmosphere. They always proceed from one region of the heavens, independent of the revolution of the earth, their relative speed is four and a half to nine miles in a second, which is the speed of the planets, the beginning and termination of their visibility vary between four and thirty-five miles. Humboldt believes that the meteoric streams which fall periodically, especially every half year, in August and November, and which are composed of myriads of minute bodies, cross the course of our earth, like the Biela comet, and form a close revolving ring, in which the asteroids are so unequally dispersed that there are few dense and many loose groups; the earth then periodically comes in contact with these dense groups, and this is the time of the meteor falls.

As we have before mentioned, Humboldt adds another circle to our solar system, besides the comets and asteroids; and this he calls the ring of the zodiac, and ascribes to it the phenomena of the zodiacal light. In describing it, he remembers his visit to the "palm-zone," where he has often seen the zodiacal light rising pyramidically, and illuminating a portion of the equally long tropical nights, often shining more brilliantly than the milky way in the sign Sagittarius, as well in the thin dry atmosphere of the tops of the Andes, at an elevation of from 12 to 14,000 feet, as in the great prairies of Venezuela, on the sea shore, or beneath the ever clear sky of Cumana. This pheno-

menon of the zodiacal light, is described in one part of Humboldt's diary, written on the voyage from Lima to the western coasts of Mexico. He says: "For three or four nights, between ten and fourteen degrees northern latitude, I saw the zodiacal light in such brilliancy as I have never observed before. Judging by the brilliancy of the stars and nebulæ, the transparency of the atmosphere in this part of the South Sea is very great. From 14th to the 19th of March, no trace of the zodiacal light was visible three quarters of an hour after the sun's disk had set in the sea, although it was completely dark. An hour after sunset, it suddenly became visible in great splendour, between Aldebaran* and the Pleiades; narrow, long drawn clouds were dispersed over the lovely blue near the horizon, like before a yellow carpet; the upper ones from time to time played into bright colours, as if it were a second sunset. In this region of the firmament, the brightness is increased like at the first quarter of the moon. About ten o'clock, the zodiacal light was generally already very faint, and at midnight only a slight trace was visible." In our dull, so called temperate, northern zone, the zodiacal light is plainly visible only in the commencement of spring, after twilight, over the western horizon, and toward the end of autumn, before the morning twilight, over the eastern horizon.

We now come to Humboldt's explanation of this extraordinary natural phenomenon, which did not excite the attention of natural philosophers and astronomers, until the middle of the seventeenth century, and whose views on the subject are as variously different as imperfect. Humboldt refutes the hitherto accepted opinion, that the luminous solar atmosphere itself causes the zodiacal light, but considers it probable that its material cause may be the existence of a very much flattened ring, formed of vaporous matter, which revolves in space between the courses of Venus

* The beautiful red star in the sign of Taurus, the bull.

and Mars. He can, however, give no explanation of the material dimensions of this ring, of its enlargement by the exhalations from the tails of the many myriads of comets which approach the sun; he can give no positive account of the strange variations in its extent, which sometimes seems to stretch far beyond the course of our earth, nor of its supposed connexion with the dense ether surrounding the sun. He presumes that the aërious parts of this ring which, according to planetary laws, revolve round the sun, are either self-luminous, or only illuminated by the sun. That bodies may exist in a self-luminous state, Humboldt proves by the fact that, in the year 1743, a terrestrial vapouring, during the new moon time, was so phosphorescent in the night, that objects could be distinguished by its light at a distance of 600 feet. In the year 1831 also, the nights were so extraordinarily light, that in northern Germany, small print could be read at midnight; and at the same time the morning and evening twilight were unusually lengthened. When Humboldt was living in the American tropics, he often wondered at the varying degree of illumination in the zodiacal light, especially when, for months he was spending the nights in the open air, in the prairies, and on the river shores. At that time, he often perceived vibrations and scintillations, and he believes that these are especially dependent on the evolution of light on the boundaries of our terrestrial atmosphere.

We have hesitatingly followed Humboldt so far into his higher phase of natural appreciation, in which he not only feels the regularity of nature in the soul, but perceives and acknowledges it. We have followed his traces at a great distance, because we feared otherwise to neglect our purpose of a general survey in the profoundness of his scientific reasonings. But in his surveys of the starred sky, he refers to the picturesque gracefulness of the firmament, and calls his readers' attention to the position of the constellations, and their dependence on the eternal regular courses and

changes of the stars. What seems to us immutability in the sky, is only apparent, caused by the incalculable distance and changes operating gradually to our limited senses, during millenniums; on every spot of the vault of heaven the same motion exists as on earth, for in this motion the whole universe has its existence.

Humboldt had most efficient and celebrated co-labourers on the field of astronomy, and during his life an immense progress in this science has taken place, as well as the improvement and perfection of the necessary instruments. Humboldt was able to follow this development of astronomical science of the last sixty years; his position secured him the intimacy of all great astronomers; he could see from the observatories, what thousands possessing high attainments only know from description; he has personally watched all discoveries made respecting the heavens and the earth, for more than half a century. Hence proceeds his knowledge of the universe, his partiality for the recurrence of the self-discovered laws of this earth in space, his ingenious explanation of hitherto unintelligible facts.

The sky exercises a mysterious charm of attraction over every one—wherever one may look with the strongest, space-annihilating telescopes, one finds stars or luminous nebulæ, of which many have already been resolved into stars; but there are also starless regions of which Herschel once said that devastations had there already taken place by time. Humboldt calls them chasms in the sky, and thinks they are views into an infinite depth of space at whose background another starry expanse lies, whose light cannot reach us. This view is almost incomprehensible to the senses, when it is known that light travels with the speed of 41,518 geographical miles in a second, and that nevertheless the light of well-known and therefore relatively very near stars travels twelve years to reach us, and that Herschel, through his famed telescope, discovered luminous nebulæ whose

rays, according to his calculations, must have travelled nearly two millions of years to reach the earth. And if we now, as astronomers frequently observe, hear of a star which suddenly loses its light, or increases it considerably, these are, as Humboldt says, events which, in their historical reality, belong to other ages than those in which we perceive them by the changes in their rays. They are voices of the past; an hour for us is for a ray of light a space of 148 millions of miles, and we may possibly be admiring a star whose last rays are now on the way to us, while the star itself may have ceased to exist ages ago.

Reflections such as these are induced by contemplating the stars with Humboldt; we learn to know, in the light of distant worlds, the oldest perceptible sign of the existence of matter.

After this introduction, the ingenuous naturalist brings us back to the real field of his experience, the earth. Considering first its form, its mean density, its warmth, and electro-magnetic power, he acknowledges, from the relations of the earth and its powers, working from the centre outwards, a universal natural force—namely, subterranean heat—which produces earthquakes, hot springs and volcanic phenomena. The surface of the earth disturbed, raised, or broken through by this force, has in the course of centuries formed the relation of the land to the water, and the form of the ocean—temporary or permanent clefts into these unknown depths serve to connect this interior of the earth with the air; fiery springs of molten masses rise gradually or suddenly from the unexplored abysses and petrify into lava, and while the ancient rocks are changed by the influence of the waters, new ones are formed before our eyes; the waters reveal remains of plants and animals, precipitations, aggregates, crushed rocks mixed with the osticular ashes of an extinct animal creation. Humboldt introduced scientific knowledge into this varied scene by thoughtful comparisons of the present with the past, of the analogous and the dissimilar, by a combination

of real phenomena and ideal views, reflected and mirrored in the entirety of nature; he brings darkly-surmised truths on the self-discovered basis of geognosy. While we know more of the interior (the weight, volume, and density,) than the exterior of other planets, we had studied only the surface of the earth, and Humboldt was the first to open the creative laboratory of the interior of the earth to the investigations of science. By means of natural fissures, shafts, and mines, we know the thickness of the superficial strata of the earth, but the greatest perpendicular depth which has yet been reached does not exceed 2000 feet, that is to say, only about one-ten-thousandth part of the semi-diameter of the earth. The masses which the volcanos eject, and which, for the most part, resemble the superficial rock, must, without doubt, come from sixty times greater depths than those which have hitherto been explored by man. Some sinkings prove that coal-beds, with their antediluvian remains, lie (for instance, in Belgium) 5000 or 6000 feet below the present level of the ocean, and that mountain limestone has probably double that depth. Add to this the mountain tops as the most elevated portion of the surface, and we have a difference of about 37,000 feet, or nearly $\frac{1}{570}$ of the semi-diameter of the earth.

No more than this is known of the thickness of the earth; and the bottom of the ocean, felt at some spots (but frequently not fathomable with a line ≃5,400 feet long) is perfectly unknown. Hence the mass of the whole planet and its mean density, can only be deduced from comparison of the upper attainable portions. Nothing which lies below the above-named depth has been examined. Nothing is known of the depths where rocks are still fluid, of the cavities filled with elastic vapours, of the condition of the fluids under the pressure of confinement, of the law of the increase of density, from the peripherium to the centre.

Humboldt acknowledges all this, and yet has given

us a science of the earth which points out the right way for a future perfect knowledge, and gives the means for a general explanation of the law which may lead to analogous conclusions on their as yet undiscovered causes. His observation of the warmth of the earth increasing with its depth, and the opposite effect of the centre towards the surface, brings him to an explanation of volcanos as the causes of the form of the earth's surface, some parts of which are raised to the regions of eternal snow, while some are split by rising vapour or burning fluids. Continent and sea interchange, and the atmosphere—the air ocean, as Humboldt calls it—covers both.

The distribution of land and water, the form of the surface, the direction of the isothermic lines, influence, as Humboldt shows, the geographical distribution of plants and animals on our planet, but the different characteristics of the human races, and their distribution over the earth, are entirely independent of these conditions of nature.

Humboldt introduces into all these branches of science that unity of observation which proceeds from an arrangement of facts according to their natural relations. It has never been his purpose tabularly to arrange isolated experiences; his descriptions begin with the form and bulk of the earth, but he did not draw his history of their origin only from the examination of their mineralogic qualities, of petrifactions and crystalizations, but he found the history of the earth's origin in its geometric form. He knew that an elliptical spheroid revolving on its axis proves a former soft and fluid body, that therefore the earth once was in a fluid and afterwards a soft state. Humboldt finds this hypothesis proved by the depression at the poles, by the elevation of the surface on the line which the moon describes round the earth, and by the elevation at the equator, the line of the greatest velocity which the soft earth would necessarily take. He calls the level of the ocean the mathematical form of the earth, which it must form as a revolving ball, but accidental

circumstances, the latent forces which caused inequalities and elevations, and formed the solid part of the earth, change the mathematical into a physical form of surface. On the first form, science has made all its graduated measurements of the earth. By eleven such measurements, of which nine were made in this century, while the two others date from the old Peruvian times, and the East Indian astronomy, it has ascertained the incurvations of this surface and the size of the earth, and it has been found by this means that the flattening of the earth spheroid, in which the denseness of the mass must increase towards the centre, is nearly equal to the $\frac{1}{300}$th part. These measurements for ascertaining the incurvations of the earth's surface have not only been made by graduated measurements, and by observations of the pendulum oscillations and the divergence in the moon's course, by geometrical astronomic means, but also from conclusions on the observed movements, on the powers generated, and by these powers back on their origin.

By these measurements, of which eight were made in Europe, it has been ascertained that the semi-diameter from the centre of the earth to the poles is $2\frac{1}{5}$ geographical miles shorter than the semi-diameter from the centre to the equator; this shows that the surface of the earth from the poles to the equator is swelled by a little more than $4\frac{3}{7}$ times the height of Mont Blanc. The observations made by the oscillations of the pendulum have become of extreme importance for science, and Humboldt justly says: "When Galileo, as a boy, saw during church service that by the duration of the oscillations of the candelabra the entire height of a church dome might be measured, he could not suppose that the pendulum rod would one day be carried from pole to pole to determine the form of the earth, or rather to produce the conviction that the unequal density of the earth strata affects the second pendulum by intricate local influences which reveal themselves similarly on large surfaces."

Thus this time-measuring instrument became as important for the geologist as the lead is to the mariner. Both reveal unseen depths; the variations in the pendulum oscillations even showed whether cavities, or dense basalt masses, exist in the depth of the earth.

When it was at last possible to ascertain the physical form of the earth by means of the moon also, science achieved a great triumph, and Laplace was justified in saying that an astronomer, without leaving his observatory, was not only able to determine the form and size of the earth, but its distance from the sun and moon, results which could, however, not have been achieved without long and laborious expeditions to the most distant portions of both hemispheres. It is a fact that the form of a planet exercises a considerable influence over the movements of other bodies, especially on the never distant moons, and therefore the form of the earth can be ascertained by an accurate knowledge of the moon's movements. And what measurements and pendulums could not establish, was ascertained by these observations of the irregularities of the moon's movements, as not only the flattening of the earth was ascertained by it, but also the proof acquired that the strata of the earth increase in density from the surface towards the centre, and thus, as Humboldt says, the knowledge of exterior forms justifies conclusions on the inner constitution of a body. The actual form of the earth, depending on the inequalities of the hardened surface, is to the regular mathematically precise form as the uneven surface of an agitated sea to the same surface when calm.

But the earth was not only measured, it was also weighed, by means of pendulum and lead. If with these simple instruments the mean density of the earth could be determined (which is much greater than pure water, being 5·44) its mean weight could also be ascertained. Even naturalists have advanced hypotheses on the interior of the earth, whose bulk must increase in density the nearer it approaches the centre; these Humboldt rejects, partly as unfounded,

partly as fabulous. Some calculated how deep in the earth fluid and aërious matter were so condensed by the pressure of superincumbent masses, as to exceed platina in hardness; others represented the interior of the earth as a hollow ball, filled with unwieldy matter and tremendous repulsive power; they even imagined animals and plants as existing on the inner surface of a central globe; two subterranean, revolving planets, Pluto and Proserpine, were said to illuminate this inner space, and near the north-pole the opening which led to this inner earth was supposed to exist. Humboldt relates that Captain Symner, a believer in this theory, repeatedly invited him and Humphrey Davy to make such a subterranean expedition. So powerful, says Humboldt, is the morbid tendency of men to fill unseen spaces with marvellous creations, totally disregarding the contradictory testimony of well-founded facts and universally-acknowledged natural laws.

The result of Humboldt's researches on the interior of the earth is a totally different and a scientific one; his views have become the basis of the present doctrines. Proceeding on the well-founded theory, that the form and density of the present earth must stand in close relation to the forces which prevail throughout it, independent of those which are produced and influenced by the sun—Humboldt arrived at his conclusions. The flattening of the earth, in consequence of the centrifugal power of a rotatory ball, shows that our earth has once been fluid. When the original mass, which Humboldt seems inclined to consider as a vaporous one in an extreme degree of heat, gradually hardened, heat must have been evolved; while the surface cooled, the centre of the earth must have remained fluid and hot, until, by the continuous radiation of heat from the centre towards the surface, a certain temperature has become permanent, and the subterranean heat has remained higher as the depth increases. This is proved by the hot waters of the Artesian springs, the temperature of

rocks lying deep in the mines, the glowing mass which volcanos eject from the depth of the earth. Humboldt does not venture to fix the boundary of the hardened surface and the fluid centre; but he considers that even in these more fluid parts, the movements of ebb and tide dependent on the sun and moon prevail. Now, as experience shows us that heat, in a perpendicular line downwards of 92 Parisian feet, increases by one degree of the decennial Celsius thermometer, granite must exist in a fluid state at a depth of 5·2 geographical miles, four or five times as much as the height of the highest point of the Himalaya mountains.

Humboldt distinguishes three modes of the development of the inner heat of the earth. The first is, that the strata of earth are periodically warmed and cooled by the sun and the seasons of the year, and thus arises a stream of heat from the exterior inwards, and then again from the interior outwards.* Secondly, in the regions of the equator, a portion of heat penetrates the earth, and flows in it towards the cooler poles, where it is again united with the air. Finally, our earth has been, since incalculable ages, in a state of gradual refrigeration; the inner central heat, which originally made the earth glowing hot, loses more and more by the gradual discharge towards the surface and into the atmosphere, although millenniums do not suffice to measure the degrees. We therefore live, as Humboldt expresses himself, between the glowing heat of the lower strata and the cold atmosphere, of which the temperature is probably below the freezing-point of quicksilver. (40 degrees of cold of Celsius = 32 degrees of Réaumur)

There are celebrated naturalists who have denied the uninterrupted increase of heat from the surface to

* This heat does not penetrate far. In the temperate zones the strata of permanent temperature begins at a depth of fifty-five to sixty feet; and at half the depth winter and summer warmth have scarcely half a degree influence on the thermometer. In the tropics, the unchangeable temperature lies one foot below the surface.

the centre of the earth; as, for example, Poisson, who declares all heat to proceed from the exterior inward; but this hypothesis can now no more affect Humboldt's theory, which if it were even only a supposition, fully explains many phenomena which would otherwise be unintelligible.

An important mysterious force of the earth, which surrounds all atoms of existence like a wonderful chain, is magnetism, to which subject Humboldt has devoted a great portion of his time. Every change of temperature produces magnetic and electric streams, and these Humboldt investigated for years by means of the magnetic needle. The electro-magnetic streams circulate mysteriously in a continual variety of development through the earth, and their changes, which are shown by the sensitive needle, occur, to the hour, according to place, solar position, and warmth, and are suddenly modified only by the polar light. The sudden interruption of the constantly-flowing earth-magnetism, which takes place during the northern light, occurs simultaneously, even if the observers were thousands of miles distant; it is like a vibration of the entire earth, or it runs like a pulsation in all directions of the earth's surface, with such extreme regularity that distances might be measured by it.

Humboldt has not been able to ascertain the causes of these sudden vibrations of the magnetic needle, the sign of disturbances and revolutions in the earth's magnetism.* It is a known fact that all matter is magnetic (*i. e.* attractive) as long as it is pervaded by electricity, and this fact may be explained by future philosophers. Humboldt discovered the variability in the mode of development, the inclination and the horizontal divergence of the earth-magnetism, to be the three phenomena by which this force can be observed on the earth's surface. He added three scientific lines as determining its equal force, equal attraction, and equal repulsion, which he called the

* Humboldt calls them magnetic storms.

isodynamic, the isoclinic, and the isogonic lines, and by imagining three lines graphically drawn over the earth, he showed thereby the vibrating and advancing direction (curves) of that mysterious force. Observations of this kind are extremely difficult and arduous to make, and Humboldt thinks that not for centuries will it be possible to understand the history of these intricate magnetic lines by accurate systematic observation. As he has always pursued this subject with great interest, he endeavoured to institute such regular experiments. Through his exertions Europe, Asia, Africa, &c., have been covered since 1828 with a corresponding net of magnetic observatories, extending from Toronto in Upper Canada to the Cape of Good Hope and Van Diemen's Land—from Paris to Pekin. The discoveries of Oerstedt on electro-magnetism, and the corresponding results of Arago and Faraday were very welcome to Humboldt. Oerstedt found that electricity developed near a body being a conductor of electricity generates magnetism, while Faraday remarked that magnetism so developed would, on the contrary, also generate electric currents. Hence it follows that magnetism is one of the numerous forms in which electricity shows itself, and science acknowledged that the two forces were identical.* But the question of the last named of the physical developments of the many and intricate phenomena of earth-magnetism is not yet answered. It is yet unexplained whether the constant change in the direction of the magnetic phenomena—which would seem to indicate various systems of electric streams in the earth—is excited directly by the unequal distribution of heat, or whether it is introduced by the solar heat, whether the planetary revolutions influence it, or whether the currents in the atmosphere have their origin in the space between the planets, in the polarity of the sun or the moon. But the magnetic observatories erected at Humboldt's instance will assist the solving of this

* Pliny had already surmised this.

mystery, for now every regular or irregular movement of this force is observed on the most distant spots of the earth, and instruments as well as the senses are now so sharpened that Humboldt assures us the persons in charge of the observatories can at certain times take down observations every two-and-half minutes for twenty-four hours, and are able to measure a decrease of the magnetic power by $\frac{1}{40000}$ degree.

Humboldt calls the north-light (the polar light or aurora borealis) the end of a magnetic storm, and considers it a phenomenon which, since Faraday has discovered that the magnetic power developes light, stands in the most intimate relation with earth-magnetism. In the morning, the evening appearance of this discharge of light is pre-indicated by irregularity in the course of the magnet, and this shows that a disturbance must have taken place in the equable distribution of the magnetic power. According to Humboldt, the north-light is a kind of magnetic discharge, (as the lightning restores the disturbed equilibrium of the atmosphere)—which is sometimes so violent that it has been seen in full daylight (at Lowervörn in 1786). This phenomenon has not only been seen at the North and South Poles, but Humboldt has ascertained that it has been met with also in the tropics, even in Mexico and Peru towards the north, so that the spectator always has his own northlight according to the angle of view. But the explanation which Humboldt gives of the existence of this north light, which only received its name from the direction in which it was most frequently observed, is of the greatest interest. He considers it a self-luminousness of the earth, a light development of the planet, in a word an earthlight in opposition to the sunlight. The planet Venus also phosphoresces on that side not illuminated by the sun, and Humboldt thinks it very probable that planets and moons, besides the received and reflected

light of the sun should discharge a self-generated light.*

While Humboldt was examining the magnetic and luminous phenomena of the earth's interior, he also observed the phenomena which the heat of the earth had produced on the earth itself, and on its formation. Here he arrived at his favourite scheme of volcanic appearances. From the interior heat he deduced the revolutions of the earth, the former elevation of whole lands and mountains, the formation of their strata and minerals, and of the gaseous and fluid earths; he recognised this interior warmth as the cause of the local changes of the earth by vibration and eruption, such as the gushing forth of hot springs, the rising of oxygen or sulphurous smoke, the ejection of volcanic matter, and the eruption of volcanic mountains. In all these phenomena, he sees only the reactionary activity of the interior of the earth towards its crust and surface. From the remains and petrifactions of antediluvian life, he judges that this reaction was formerly more powerful than it is now, that the oxygen must then have been discharged into the atmosphere more abundantly than at present; that it must, by the imparting of oxygen to plants, have produced a far more fertile vegetation; and this is shown by the extinct traces of former forests, the tremendous coal deposits, and other buried, burning materials. The earthquake—that perpendicular, horizontal, or circular vibration of the earth's surface and crust, which science can now measure in direction and force with tolerable accuracy, which is accompanied by dull noises and subterranean thunder, while the springs often dry and great desolation is caused—this became, for Humboldt, an important means to the knowledge of the earth. His

* Besides this aurora borealis there are other forms of terrestrial light. Humboldt includes among them the yet unexplained weather lights, the dry luminous fog of 1783 and 1831, the steady light of large clouds which Rozier and Beccaria observed, the bright nights of autumn and winter, &c.

experiences led him to the conclusion that earthquakes were always taking place every minute in some portion of the earth; that therefore the interior of the earth was constantly reacting upon the exterior, that probably the high degree of heat of the earthy masses in their depth, where they exist in a molten condition, is the cause; and that therefore the agitation is not confined to certain species of mountains, but may occur on any spot of the earth. But from the observance of simultaneous distant agitations, from the direction of these earthquakes and waves which frequently cross each other, from the subterraneous noise which is often heard at miles distant from the active volcano or the revolutionary portion of the earth's surface, Humboldt recognised certain subterranean connected veins of volcanic activity, having their safety valves in the eruptive volcanos, and either discharging their explosive masses from the crater, or, if these craters are choked, finding another, and, for the inhabitants, a more dangerous outbreak for their fluids expanded by heat. Sometimes they are not ripe for eruption, and only produce earthquakes. Electric fluids, expanded by heat, are, according to Humboldt, the cause of all volcanic phenomena, from the faintest vibration to the most terrible eruption. These expanded vapours of boiling water, or melted metals and rocks, rising, roll along the volcanic galleries in the earth's interior, often find their outlets choked with crystallized or cooled masses, and then the pressure of expansion raises the earth or imparts the waving motion of the elastic fluids to the more solid mass.

But Humboldt also recognised the chemical changes in the earth's surface and in the atmosphere, as caused by the inner vital heat of our earth. The vapours exhaled the oxygen gas which the earth discharges into the atmosphere itself almost free from nitrogen; many other peculiar gases which rise from various clefts in the earth seemed to Humboldt the evident proofs of a constant burning process existing in the

centre of the globe. These fountains of air often precipitate the matter they contain, and are frequently met with in such districts where volcanic traces are not even visible on the surface of the earth. It has been before mentioned, that Humboldt explains the greater richness and luxuriance of antediluvian vegetation by the greater quantity of oxygen it received, and this rose principally from the oxygen springs, of which many yet exist (mofettes) and which gave abundant nourishment to the plants. What the plants could not consume was absorbed by the chalk mountains of the surface, and thus gradually drawn from the air, which has thereby become respirable for men and animals. Fluids, slime, and melted earth, still rise from the centre of the earth, as well as oxygen and other gases, and the depth of their origin in our planet can be calculated by their heat. Humboldt connected the places of equal mean temperature on the surface of the earth by isothermic lines, and on the same system it was intended to draw certain lines showing the equal interior heat, to be called isogeothermic lines, and these were to be determined by the temperature of the waters which rise from the centre of the earth and flow from the tops of the mountains; but this method gave very unsatisfactory results compared to Humboldt's plan, as the temperature of these waters is very relative and depends on many extraneous circumstances. Cold springs only have a mean temperature when they, without coming into contact with the deeper warm springs or the cold ones from the mountains, have flowed for a considerable space in that strata where the permanent temperature of the earth begins, where the warmth of the air is not influenced by seasons or by day and night. (This, in the temperate zone, is from forty to sixty feet; in the equinoctial regions only one foot below the surface.) As regards the hot springs, Humboldt declares, that all those which he and others have discovered are situated at a distance from all volcanos; that, therefore, the heat of the interior earth gives

them their permanent or occasional heat (sometimes from ninety-five to ninety-seven degrees), that the hottest are always the purest, and that the greater heat of the springs must be occasioned by their rising from a deeper, *i.e.*, hotter source.

Humboldt has given some interesting explanations of the slime which is ejected from some portions of the earth, founded on his investigation of the American and Caspian mud volcanos. He considers these eruptions, which are not caused by earthquakes or by fire, as a link of the chain of phenomena by which the earth's centre acts on its surface, as something between fire volcanos and hot springs; they are the organs of an uninterrupted but weaker action of the planet, by which a communication between the centre and the surface had formerly existed, but which have been choked up, and where the cold slime now rises from an inconsiderable depth, while the fire volcanos are yet in *direct* communication with the glowing centre. Humboldt has made considerable investigations into their origin; he considers them vaulted elevations of the earth's surface, raised by elastic vapours, which have broken through and separated the earth's strata. This produced a basin, or kettle-shaped hollow, in whose centre a crater and cone formed itself. When the connexion between this opening and the inner earth is stopped, the volcano is extinct. In a similar manner volcanos have risen from the bottom of the sea, and have become inhabitable islands.

We have yet to mention another phenomenon investigated by Humboldt, namely, the volcanic storms, so named by himself. These are formed by the hot vapours which rise in the air during the eruption of a volcano, and which, in cooling, form a cloud which surrounds the fire-pillar often many thousand feet high, and from which lightning breaks forth and thunders roll; these are caused by the sudden condensation of vapour into clouds, which excites the violent electric discharge.

Being unwilling to enter into the details of Hum-

boldt's scientific acquirements, as they are collected by him in "Kosmos," we must omit his classification of volcanos into central and connected ones, especially as this system has been introduced into science by other naturalists. We will return to Humboldt's peculiar field, and treat of his results on the creative and destructive volcanic power, in reference to mountains and rocks.

This brings us to the extensive field of mineralogic geognosy, on which Humboldt always worked with great predilection with his old friend Leopold von Buch, and which treats of the formal composition and arrangement of the earth's strata, and gradually leads to the geographical form of its surface. The strata of the earth were to him the pages of a large book in which he read the events of the past; the kinds and forms of rocks he interpreted as the great characters of a history of creation extending over many thousands of years. He perceived the process of the formation of mountains as fourfold. He calls the matter which has once been projected from the interior of the earth in fluid masses, and which has now become more or less solid, eruption rock;—that matter which was contained in the fluid in small particles, and has been gradually precipitated, he calls sediment rock, and includes among it the greater part of the horizontal strata of earth, the so-called tertiary groups, which lie above the chalk formation, and contain fossil remains of mammalia, crustacea, &c. The transformed rocks are those changed by contact with volcanic or precipitated earth, or by vaporous exhalation or absorption of matters from below, while by conglomerates he means the sand and rock formation composed of mechanically-separated masses of the three other classes. All these four species Humboldt describes as still progressing in their formation, the action of fire and water, though not so violent as formerly, is still exercising its influence. Among the first class, the eruption rock, Humboldt includes granite and Syenite,* the quartz porphyries,

* A mixture of feldspar and hornblend, called after the town of Syene, in Upper Egypt.

greenstone, hypersthene rock, Euphotede and serpentine, Melaphyr, Augit, Uralit and Oligoklas-porphyr, Basalt, porphyr-slate, Trachyt and Dolomite. All those which former science included among the transition, horizontal, secondary or tertiary formations, Humboldt calls the sediment rocks, the precipitates and deposits of stalactite fluids, such as limestone or clayslate, whether the matter has been previously chemically dissolved in water, or only mixed with it in fine particles. To this class belong slate, coal deposits, limestone, Travertine (fresh water limestone, flint guhr*), and the real infusoria deposits,—a kind of earth, which, as Ehrenberg has proved, consists entirely of the bodies of infusoria, and which covers immense spots of the earth's surface. The sandstone formations are those rocks which Humboldt calls conglomerates. Humboldt proved that rocks, formerly different, may have changed, and that modifications are still continuing, and may be detected by comparative observations on the slowly-progressing changes in the great laboratory of nature, by direct chemical experiments, which, imitating in miniature the great processes in the laboratory of the earth, give the most simple conclusions.

As regards the geographic distribution of the rocks over the earth, the most prevailing material is carbonated lime; the next is the combinations of silicum with clay, of kali and natron with limestone, magnesia, or iron oxyde. As regards the age of the formations, the eruptive mountains are the oldest, and if remains of antediluvian animals and plants are found in any earth, its later formation is thereby proved. An extinct animal and vegetable life lies buried in the upper and middle strata. Humboldt justly says: "We ascend into past ages when we descend from strata to strata, investigating the position of deposits."

Humboldt, with his mind's eye, surveys the surface of the earth, explains the distribution of land and

* Formed almost exclusively of the silica of microscopic infusoria of the primeval world.

water from the other creative processes of the planet, and ingeniously connects the geographic knowledge of the earth with geology. He considers the present form of the continent as an elevation above the level of the sea, produced principally by the eruption of quartz porphyry, which has broken through the primeval terrestrial vegetation, as shown in the present coal deposits. What we call lowlands, Humboldt describes as broad ridges of hills and mountains, whose bases lie at the bottom of the sea—a table land, in short. The horizontal form of the land of the planet, —which is as 1 to $2\frac{1}{5}$ to the quantity of water, and of which there is three times more on the northern than on the southern oceanic hemisphere—has occupied Humboldt's investigating mind, the more as even in the times of Grecian antiquity it had excited great interest. The direction which the longitude measurement of the old and new world takes, has led Humboldt to new researches. Our old continent has its greatest length from east to west, while America has hers from north to south; and while, in the north, these two continents are abruptly cut off at their greatest breadth, they terminate in the south in pyramidical points, which Humboldt thinks the more characteristic because this southern pointed form is repeated on all the smaller quarters and peninsulas; and it has been proved that, the more simple the coast form and the divisions of a continent appear, the more uniform has remained the education and civilization of the inhabitants. He compares the much divided Europe to the uniform Asia, Africa, and South America. He acknowledges a subterranean power as the operating cause of all continental formation which did not create the entire continent at once and simultaneously, but at different epochs, by extension and elasticity of hot vapours and exhalations, which have, at different times, raised the earth's surface over the water, and by subsequent earthquakes and eruptions, formed the details of hill and valley. This elevation and revolution of the continent, Hum-

boldt, according to his own and his contemporaries' researches, does not consider as completed, but as still continuing. As there are yet portions of the earth's surface which lie below the level of the ocean,—for instance, the Caspian Sea,* the Dead Sea, the former 625, the latter 1230 feet below the level of the Mediterranean,—so whole territories rise still, though perhaps scarcely perceptibly in the course of a human life. Thus the eastern shore of Scandinavia has risen 320 feet during 8000 years; and Humboldt calculates that in 12,000 years, those portions of the sea near the shore, which are now covered by fifty fathoms of water, will be raised to the surface and become dry land. Thus the growth of the continent is proved! But if, on the one side, land is rising above the sea, one may also imagine a gradual sinking on the other; and Humboldt plainly foresees that some north-western portions of Europe, by the gradual depression of the surface, will sink below the water level and become sea. There is an absence of any proof for a real increase or decrease of the ocean, although in former ages the level of the sea was undoubtedly a widely different one to the present.

Over the mountains and the plains, and over the unstable surface of the ocean, lies the earth-surrounding sea of air, to which the oceanic waters refuse to impart their warmth, as the refrigerated particles of water become heavier, and fall into the warmer depth. But as the air ocean has its wind currents, which return according to regular laws (which Dowe especially has investigated), so there are also oceanic currents, which Humboldt has made the subject of interesting researches. Besides the well-known phenomena of ebb and tide, the movement of the waves in obedience to prevailing winds, and periodical air pressure, there

* Humboldt remarks that the periodical, irregular rising and falling of the waters in the Caspian Sea, seems to be a proof that the soil is yet capable of making weak oscillations, even without earthquakes, which must have been more universal at the period when the earth's crust was less thick.

are currents which cross the oceans like rivers, and flow past the unaccompanying waves like quiet shores; these are the so-called oceanic currents, which Humboldt has most attentively investigated. The principal of these is the Atlantic Gulf stream. It rises south of the Cape of Good Hope, runs across the Sea of Antilles and the Bay of Mexico, through the Straits of Bahama, proceeds in a north-western course from the United States, receives an eastern direction near the Bank of Newfoundland,—where one arm runs southward and flows to the shores of Iceland and Norway, to which it frequently brings, besides its warmth, various objects from the tropics. In the Southern Ocean there is a similar current, which, however, has a low temperature, while the Gulf Stream has a high one. We mentioned Humboldt's investigations on the nature of the Gulf Stream when we were sketching his American journey.

Humboldt adds to the sketch of nature which he has composed according to his own scientific acquirements, a sketch of the great ocean of air which surrounds our planet. He has investigated it accurately in the changes of its pressure, its climatic warmth, its humidity and electricity, and its universal barometric changes. The wonderful rotatory laws of the winds, discovered by Dowe, occupied much of Humboldt's attention, for they led back to universal laws which Humboldt had discovered in other phenomena of natural life. His arrangement of the frequently mentioned magnetic observatories which cover the earth he has endeavoured to make subservient for experiments on the laws of winds, and he anticipates important results on the regulation of winds from these connected simultaneously-made observations.

When we were speaking of Humboldt's Asiatic journey we mentioned the universal influence of the prevailing winds over climate, and as they have some effect in the distribution of heat, whose scientific classification was Humboldt's special aim in the isothermic lines instituted 1817, we enter here on a

new field of his pre-eminent activity, namely, that of comparative climatology.

Humboldt has a much more comprehensive view of climate than has hitherto been accepted; all terrestrial forces are combined in it in his acceptation of the term, and his explanation of the varying climates and their causes is based on general scientific laws. The places he connects by the isothermic lines are far from parallel with the equator, for the many causes which modify the temperature influence their direction. The temperature is raised in the temperate zone by vicinity to the western coast, to bays or lakes, by the situation of the place in relation to large plains, or oceans free from ice, by the prevalence of south or west winds, by protecting mountain-ridges, by the absence of marshes which would remain covered with ice, by absence of forests on a sandy soil, by pure sky, and by the vicinity of a warm ocean current. The opposite of all these must make the temperature cooler, but in general in the temperate zones, especially in Europe, the eastern coasts are colder than the western, because the east winds come over cold countries, the west winds come across the sea. Humboldt says, that the studies of his friend George Forster have especially led him to these results.

As the temperature, properly, grows colder with the height of latitude, or the distance from the equator, Humboldt paid especial attention to this on his investigation of meteorological precedents, his institution of botanical geography, and other scientific plans, and he says that on his many journeys in and out of the tropics the comprehension of this law of the decrease of temperature with increasing latitude, has always been a prominent subject for investigation. To these may be added his results on the snow boundary, the humidity and the thawing power of the air, and on electricity.

But from this view of our planet, which he seems to have built before our eyes, Humboldt goes on to the organic life of plants and animals; the anim[illegible]d

surface of the earth became no less the object of his investigation than the fiery fluid, or petrified form of the planet and its outer form.

With the infusoria he begins his account of the animal kingdom, and with the microscopic plants, as an entire perfect plant, the circle of vegetable life. Humboldt was assisted in his general investigations of this organic world by the most distinguished contemporaries, who revealed the secrets of the smallest space by means of the microscope, and discovered life, motion, and repetition of the universal Cosmodian conditions of existence in every vegetable or animal organization invisible to common eyes. Organic life is active everywhere on the surface of the earth, in its precipices and its atmospheric altitudes; the great ocean contains minute microscopic life far into the polar circles of the arctic ocean. It has been proved by direct observation, that "in the eternal night of oceanic depths," as Humboldt expresses himself, more animal than vegetable life is developed, while on *terra firma*, the vegetable principle prevails; yet the bulk of the latter far exceeds that of the former, although there is less land than sea. Modern naturalists believe they have discovered infusoria in the air. Humboldt considers this discovery still doubtful, but not impossible; he thinks that just as well as it has been proved that pine pollen falls from the atmosphere, it is possible that little infusoria may be raised upwards in vapour, and be retained floating in the air for some time.* Ehrenberg has also discovered that the misty dust rain which clouds the atmosphere near the Cape Verd islands, 380 leagues from the African coast, consists of the remains of eighteen different silicious, polygastric infusoria.

Humboldt classified plants and animals first, according to their social or their isolated character. In his

* Even in portions of melted ice floating in round pieces in a latitude of 78° 10′ more than fifty kinds of silicious polygastria were found, as well as coscinodisks with their green ovaries, beings therefore capable of supporting life in the extreme of cold.

"Flora Friburgensis," which was published in 1793, he called those plants social, which always appear in groups, and cover large surfaces uniformly, thus contributing to give a physiognomic character to a landscape, which the moving, often travelling animals, cannot do. But the interest of Humboldt's geographical conception of plants, lies in his classifying them according to climate, whereby they are regularly ranged one above the other, on mountains, as they increase in height, and the belt of the mountains has a warm, a temperate, or a cold climate. Humboldt, in subsequent years, says of himself: "It was a fortunate circumstance of my life, that at a time when I employed myself almost exclusively with botany, my studies, favoured by the view of a grand climatically contrasted nature, could be directed to this subject," namely, to connect the geography of plants with the theory of the distribution of warmth over the earth, to regulate plants according to their natural families, and then distinguish them numerically.

Humboldt endeavoured to apply the principles which he had founded, and which include especially the direction of the isothermic lines, which he draws over the earth, to connect all points of equal mean temperature, and on which the botanical geography naturally depends, to this subject; he endeavoured to apply these principles also for a geography of animals, although these latter are more apt to change their location at will, between the equator and the poles, while the plants wander only in the egg (as floating seeds), and once rooted, remain dependent on soil and temperature.

But in a perfect sketch of nature, man cannot be omitted. The human race was therefore also studied in its physical degrees of races and tribes, and their geographical distribution. This knowledge, Humboldt endeavoured to obtain, by a more accurate investigation into the history of civilization, of race, of common language, of modification in the original tendencies of mind and feeling. He also arrived at

the conclusion of the unity of the human family; whose different races are but forms of the one only kind, which opinion other naturalists had also already established. Languages also seemed to him as the intellectual creations of humanity, and being allied in their development, they bore the stamp of nationality, and have, therefore, become important, as means to recognise the similarity and the variety of human races. Language is to him a part of the science of the mind; a sphere surrounding humanity, as a spiritual chain, but here with mankind, he fixes the boundaries of his sketch of nature, which he will not exceed.

CHAPTER XI.

THE SENSE FOR THE ENJOYMENT OF NATURE IN OPPOSITION TO OBJECTIVE OBSERVATION—NATURE AS A MEANS OF IMPROVEMENT FOR THE MIND AND HEART—HISTORY OF A PHYSICAL VIEW OF THE WORLD.

WE have given the chief features of Humboldt's general views of the physical arrangement of the world in a brief summary. But, as we had occasion to remark in his short biography, an important feature in Humboldt's character is, that he not only thinks and observes, but that he also *feels*, and that he discovers the beautiful in form and movement, as clearly as he describes it. Natural science is to him, not a matter of memory, but of life, not only mental activity, but mental improvement, not only the knowledge of the world beyond us, but a means for the better development of ourselves.

Humboldt teaches us in a most attractive manner, how natural studies can be a means of civilization, how man may be thereby induced to perceive the reflection of the outer world on his own imaginative power, by the feeling of poetical enjoyment and reproduction, by the art of landscape painting, by the cultivation of plants and of exotic flowers, and finally, by understanding the great natural laws, first in detail, and then gradually in their entirety. This Humboldt teaches us in a most attractive way. At the conclusion of his picture of nature, he departs from the purely physical contemplation of natural objects,—a contemplation which he has throughout purposely denuded of everything approaching to an imaginative garb,—and proceeds to investigate the subject with regard to its influence on the feelings of the human mind.

This produces that higher degree of natural appreciation, of which Humboldt, on another occasion, says, that it springs from ideas from a comprehension of nature. The pictures of natural life received by the perceptive faculties, are reflected on the feeling and the imagination, and thus reveal an inner world in man. This inner world must be studied by intelligent men, for it teaches us to know the source of our reasonings, of our mental activity, and our emotions. By exciting the phantasy, which first is agreeably impressed by the view of natural objects, and afterwards endeavours to retain the fugitive picture, most men are excited to a nearer acquaintance with objective nature. The desire for distant, new, unknown forms of nature is excited, with it the attempt at a poetical treatment of natural scenes, at artistic representation of the beauties of nature in landscape painting, or the cultivation of graceful or noble plants and animals. Humboldt wishes to make all these feelings more universal, more intelligible, and more productive, and therefore, at his advanced age, he begins to write on it. The second part of "Kosmos" treats exclusively of this subject.

Starting with a description of nature, he endeavours to describe the feeling for nature as it existed in different ages and nations; he shows that in the remotest antiquity, the time of the Hebrews and the Indians, feeling for nature was not quite absent, though less loud and evident; that the Greek had neither description nor poetry of nature, and only took landscapes for no more than the background for passions, heroisms, &c., delineated by human figures; that the Roman was still more sparing in his susceptibility for the beauties of nature, and left this sense undeveloped, spite of his country-life and tillage of the fields, in the cold solemnity, sober prudence, and exclusively practical direction of their popular life; how, with Christianity, the feelings of the ancients, till then dead, and directed only to action and to the expression of human power, and not to external objects, were inspired with new senses; how, with

the civil liberty of the human race, the view of the great nature was extended, and with the love of solitude, of solemn reflection, and self-examination, the feeling of beauty and order in nature sought to admire the goodness of the Creator; how Christianity inspired individuals of the Germanic and Celtic races, more devoted to adoration of nature, to investigate the preserving and destroying forces in nature, and thus incurred the risk of falling a victim to the belief in sorcery of the common people: but how, in the middle ages, the unconcealed joy in the pleasures of nature was developed, mixed, in the Indo-Germanic races of Northern Europe, with romantic sentimentalism; how, finally, in more modern centuries, depth of feeling and vivacity in the appreciation and influence of nature prevail among nations. Humboldt describes all this in an instructive and interesting manner, and he then advocates that poetry of nature where the poetical is born from the secretly-felt union of the sensual with the intellectual, from the feeling of universality and unity of natural life.

Landscape-painting has also, in Humboldt's opinion, an influential effect as an incentive to natural studies; it increases a love for nature. On this subject, Humboldt enters into the gradual introduction of landscape-painting, which, in its real development, belongs to the latest period of the middle ages, and owes much to the brothers Eyck. The greatest era in landscape-painting was the seventeenth century; at that time there lived Claude Lorraine, the idyllic painter of light and of clear perspective; Ruysdael, grand in dark forests and threatening clouds; Gaspard and Nicholas Poussin, distinguished for their representation of romantic scenes; Everdingen, Hobbema, and Cuyp, for their fidelity in copying nature. These painters, says Humboldt, intelligently copied what the vegetation of Northern Europe, of Southern Italy, and of the Iberian peninsula, offered them. But he recognises a higher grade of landscape-painting in the representation of individual forms of nature, which was not possible till the geographical knowledge of

the world was extended by travel, and the sense of beauty was developed by the investigation of botanical forms. At the present time single individual forms of exotic plants, single fruits, branches, or buds (by Johann Breughel), the individual characteristic of the torrid zone (by Franz Post, of Haarlem, and Eckhout, who accompanied Prince Maurice of Nassau to the Brazils), are made the subject of pictures; landscape painters have also commenced to represent the simpler forms of our indigenous flora, with a fertile and creative phantasy and a depth of feeling, which nevertheless reflects the whole of nature, because on every spot of the earth nature repeats herself.

We have only briefly sketched Humboldt's views on landscape-painting; he demands natural physiognomy in a landscape; the picture is to express the dark feeling of a local natural character; and to conceive and adequately represent this feeling, Humboldt considers as the task of a landscape painter.

But still he describes this impression of a picture as less exciting and narrower than the direct sensual perception of exotic plants in hothouses or parks, and distinguishes the artistic impression from the contemplative botanical interest; and although plantations and gardens have not the varied means of landscape-painting—such as light and colouring, the command over form and quantity, the mysterious unbounded distance of perspective—that is quite compensated by the impression which REALITY always exercises over the senses. Humboldt is very partial to such living garden-landscapes, and wishes to see his descriptive botanical physiognomy applied as a means in the art of landscape-gardening.

We must now follow the great man, whose portrait we are endeavouring to draw, on another intellectual field, which he has made abundantly fruitful; this is the history of the physical contemplation of the world, the knowledge of the gradual development

and extension of the conception of nature *in its entirety*. For the desire of humanity to know heaven and earth, and to comprehend the connexion of the great natural forces in both fields, has existed since the remotest ages, and among the oldest nations of antiquity. A contemplative observation of the phenomena and developments of nature, has, in all ages, been indispensable to the intelligent, and the progressive knowledge of nature, in its relation to the universe, has always kept pace with the civilization of mankind. Like all knowledge, this first contemplation of nature begun with single objects, and the presumed intimate connexion of these with entire nature. With increasing civilization this supposition became a knowledge of nature, and the prophetic phantasy of a Plato, Columbus, and Kepler, dimly pointed to the end which experimental science subsequently attained by other means.

The gradual development of the comprehensive faculties of humanity, which produced the notion of the unity of all natural phenomena, as a whole, intimately connected in all its parts, is produced, according to Humboldt: first, by the independent pursuit of human reason of the knowledge of natural laws—or a thoughtful observation of the phenomena of nature; secondly, by the great terrestrial events which have suddenly extended the horizon for study; thirdly, by the invention of new means for the extension of actual observation, (as telescopes, microscopes, and other optical and scientific instruments) which has brought us into nearer intercourse with the objects of this earth, and with those of the most distant regions, having thus strengthened and multiplied our capabilities of perception.

Humboldt started from these three features of the causes of progress in his studies on the history of natural contemplations; and on this field, also, his universally developed mind was of great assistance to him. He traced the *gradually* increasing knowledge of nature, the consequence of a latent endeavour for

improvement in man, from the oldest natural history of the old Hellenes. He calls the great world events, such as the voyage of Colæus from Samos, to beyond the pillars of Hercules, the expedition of Alexander to India, the dominion of the Romans, the spread of the Arabian religion, and the discovery of America, *sudden* means of increasing the knowledge of nature, especially in the life of those nations which once inhabited the shores of the Mediterranean. And, at this point, Humboldt refers to languages which each operate as a means of communication between separated nationalities, and which, by comparison with each other, by an investigation into their constitution, and the similarity of their character, assist in the study of the human races.

Humboldt likes always to build his investigation on some object, in all his observations which lead him to universal subjects, and, thus, in his description of the world in general, which is represented principally by natural, philosophical, and rarely by perceptive illustrations, he seeks some point of earth upon which he can advance contemplatively and experimentally. He takes, for this purpose, the Mediterranean Sea as the circumscribed space, round which those nations lived who prepared the foundation for our subsequent western civilization. From these shores of the Mediterranean he explores the course of civilization, and finds the history of the knowledge of nature advance progressively with civilization, but not proceeding from one, but from several primitive nations. In the remotest antiquity, at the extreme horizon of past historic ages, we see, contemporaneously, several bright stars from which the rays of civilization, crossing each other, have flowed on, as in Egypt, Babylon, Nineveh, Cashmere, Iran, and China. Humboldt says, on this occasion, "these central stars remind one, involuntarily, of the greater among the dazzling stars of the firmament, of the eternal suns, in space, of which we perceive the brilliancy of their light, but do not know, except of a very few, their distance from our planet."

Humboldt, following his usual method, takes the Mediterranean as the point where he begins his physical history of the world; he divides the Mediterranean into three parts; the Egean, the Ionian, and the Tyrrhenian seas, and recognises these forms of the thrice divided Mediterranean as exercising a great influence on the earliest boundary, and earliest extension of Phœnician and Grecian voyages of discovery; he shows how important is the physical form of the coasts in the course of events, the direction of naval expeditions, and the change of government, also as a mode of developing ideas. From thence he traces the paths of the early civilization of the Hellenes, as shown in their voyages in a north-eastern direction, by their argonautic expedition to Colchis, towards the south by the Ophir expeditions, and westwards by Coläus of Samos, and as evinced also by the campaigns of Alexander the Great, which opened new roads of civilization, and for the advancement of ideas, as new portions of the earth were included in the circle of universal knowledge by conquest, language or literature. The Greek spirit encouraged the intermingling of nations, from the Nile to the Euphrates, from the Jaxartes to the Indus. The extension of the knowledge of the world was a sudden one, both by individual study of nature, and by intercourse with other ancient civilized and commercial nations.

Humboldt pursues the increasing knowledge under the Ptolemeans, after the dissolution of the Macedonian empire, and sees in the commerce of Egypt with distant countries, in exploratory voyages to Ethiopia, in the long ostrich and elephant hunts, in the menageries of the royal palaces of Bruchium, &c., stimulants to the study of natural history, and to the increasing store of observations which were made at this era of the Ptolemean, and of the Alexandrine school, less by observations of individuals, than by order, comparison, and explanation of formerly acquired facts. He then points to the foundation of the Alexandrine Museum, and of two libraries, as the results of the practical sense, the comparative obser-

vations, and the universalising of the natural science of that age. It was, as Humboldt expresses himself, the age of encyclopedic learning; a connexion of the knowledge of heaven and earth—where astronomical and geographical progress was made—where the movements of the planets were more accurately ascertained, but where, at the same time, all knowledge of the absolute size, form, mass, and physical constitution of the world remained on its old footing.

In the Roman world dominion, Humboldt sees the first signs of an union of the three above-named divisions of the Mediterranean into one confederation, connected with other great continents; he sufficiently appreciates the influence of a great confederation on natural science; he sees the different previously individually progressing streams of civilization united here; Rome had become the centre of this great new circle. Geology was advanced by tillage; Strabo and Ptolemaus rose up as the supporters of geographico-physical and mathematical science; mathematical optics and chemical science commenced; and Pliny made his first attempt at a physical geography.

And now Christianity appeared. In it, Humboldt perceives the origin of the gradually progressing feeling of the unity of the human race—the great fountain of benevolence, of the humanising of nations in their morals and manners. He has thus recognised four great eras in the progress of knowledge in the universe. 1. The attempts to advance from the shores of the Mediterranean eastward towards Pontus and Phasis; southward, to Ophir, and tropical auriferous countries; and westward, towards the pillars of Hercules, in the ocean. 2. The Macedonian campaign under Alexander. 3. Period of the Lagides; and 4. Roman dominion: but, he acknowledges besides, the immense influence of the Arabian invasion, which introduced a foreign element into European civilization, and of the discoveries of the Portuguese and Spaniards in the six or seven centuries subsequently occurring. Both these events considerably advanced and extended

physical and mathematical science, and the knowledge of astronomy and geography. Henceforward, says Humboldt, the advancement of cosmical knowledge was no longer dependent on single political events, but on the events occurring in space. The Arabians, a Semitic, primitive race, not only opposed barbarism, but went back to the sources of Greek philosophy, and opened new paths to natural observation; therefore Humboldt, who has so well proved that the life of nations is influenced, besides their intellectual qualifications, by many objective conditions, of soil, climate, and vicinity of the ocean, perceives in the irregular form of the Arabian peninsula, an important reason for the great intercourse this nation had with the world, and their consequent influence on the study of natural sciences, which was particularly favoured by their native love for nature and her powers. They cultivated pre-eminently medical science and chemistry, and founded a new scientific era in the latter. Humboldt pronounces the importance of chemistry to consist in this, that through it the first knowledge of the difference of matter, and of the influence of its powers not visible by movement, was obtained, and that thus the *admixture* of matter became a branch of knowledge, as well as the *form*. But the knowledge of the earth in the heart of the continent was also cultivated by the Arab intellect as well as astronomy, and mathematic science in general.

And now came the era of oceanic discoveries; the fifteenth century impelled all intellectual labour towards one goal; the views of the middle ages were gone, and a new age was preparing.

The western hemisphere was discovered—the first ineffectual discovery of America in the eleventh century became, through Columbus, a new discovery of civilization. The partiality which Humboldt shows for this event, and its consequences, in all his descriptions, is explained in the biographical account of his life. He was, in contrast to Columbus, the geographical discoverer of the American tropics, the scientific dis-

coverer of those districts; his great work was directly allied to the results of the physical knowledge of the world acquired by these oceanic discoveries, which extended the horizon by a new world. Humboldt's name, therefore, ranks with those of Albertus Magnus, Roger Bacon, Vincent de Beauvais, Columbus, and Gama. The two last named men are the conquerors of the space on which Humboldt cleared away obscurity, and opened the land to science. But the Pacific was also opened to the comprehension of men; not only the form of the western coast of the world, but the form of the eastern coast of the old world, was ascertained, for, as Humboldt shows, the knowledge of the numeric relation of the bulk of water and land on our planet was freed from erroneous results, and the condition of many other phenomena, such as the degree of moisture in the atmosphere, the varying atmospheric pressure, the vegetative power of plants, the greater or lesser distribution of certain families of animals, was explained. The western nations of Europe had, therefore, the richest store of material for a study of physical geography at their command in a very excited age, where a numerous European population were in the most direct intercourse with a great, new, and magnificent tropical nature in the American plains and mountains.*

Vega says that man, on his journeys to distant regions, sees land and stars change at the same time, and it therefore follows in the development of natural knowledge that important discoveries on the earth must increase our knowledge of the world, or, more accurately, of the firmament. By the employment of perflected telescopes new regions of the heavens were revealed, and a new world of ideas born. Columbus gained a large space of earth for humanity; Copernicus, almost at the same time, made similar discoveries in the universe, and the telescope enlarged the circle

* Compare Humboldt's critical investigations into the historical development of a geographical knowledge of the new world and of nautical astronomy in the fifteenth and sixteenth centuries.

of this human knowledge to infinity. Kepler discovered the great forces of the movement of world-bodies, which Copernicus had surmised; and the great theory of gravitation which Newton introduced changed physical astronomy into the mechanics of the sky.

We do not follow Humboldt in his illustrations of the history of the development of astronomy from Galileo to Kepler, and of the mathematical epoch from Newton to Leibnitz, because he has only collected the results of his predecessors in his own manner, and it does not include his own special researches. But with the discoveries of his contemporaries, Humboldt is intimately connected, for he had a direct or indirect share in all the advances made in natural sciences. Therefore his assistance in the sciences of the heavens and of the earth is gloriously pre-eminent in the great branches of study on warmth, light, magnetism, and all great forces, whose better explanation is the intellectual triumph of the present age.

We have thus endeavoured to give another intellectual portrait of Humboldt, by a general sketch of his "Kosmos," which we have made with all possible fidelity. But the great work is not yet completed; a third and last volume will give us the results of the discoveries on which the present condition of science is principally founded. And as "Kosmos," the great legacy to the German nation, is still incomplete, the life of Humboldt is also incomplete, and we take leave of him with the ardent wish that he may yet dwell for many years on this earth, with whose mysteries he is so familiar, and from which he has culled such abundant fruits of knowledge.

CHAPTER XII.

GLEANINGS OF HUMBOLDT'S LIFE—ILLUSTRATIONS OF TRAVEL AND OF NATURE.

THE life of Alexander von Humboldt is so fertile in objective and subjective events, that it was impossible to represent the various scenes of his adventures, scientific and social, in former chapters. We often hurried over events, views, and landscapes, in order not to fall from the field of the biographer into that of the writer of travel; but we often wished to tarry longer, and give the dangers and impressions of new, bold discoveries, or try the effect of many a beautiful natural scene upon the mind of our reader. As we wish, however, to satisfy the readers of this biography in this respect also, and bring Humboldt before the people in the various circumstances of his glorious activity, and in order once more to follow him in his thoughtful contemplation, clear explanation, and instructive tuition of nature, we have gleaned some stray sheaves on the paths traversed in the previous chapters. We append, therefore, some scenes of travel, natural phenomena, and views, extracted from Humboldt's writings, as a gallery of sketches which will fill up the crude outline, and the gaps in our portrait of Humboldt.

ASCENT OF THE PEAK OF TENERIFFE.

The real ascent of the mountain begins at Orotava. Early in the morning of the 21st June, Humboldt and his companions were on the road which leads to the summit of the mountain. It was not an agreeable day, and, from sunrise until ten o'clock in the morning, clouds covered the point of the mountain, which, with a clear sky, would have been visible from Orotava. (Humboldt says:—The journey to the peak of Teneriffe is the same as the journeys to the vale of Chamouni in Switzerland, and to the summit of Mount Etna in Sicily, where the traveller is obliged to follow his guides, and sees only what other travellers have before seen and described). A narrow stony path led from the town of Orotava through a fine chesnut grove into a district covered with bushes, and with several varieties of laurel and tree heath; the stems of these heath-plants have a considerable thickness, and flower nearly the whole year.

Arrived at the station Pino del Dornajito, Humboldt had a splendid view of the sea and the northern portion of Teneriffe. A very voluminous gushing spring found here showed a temperature of fifteen degrees warmth, which was very surprising to Humboldt, because the temperature of springs is generally the same as the mean temperature of the locality, and the barometric altitude measurement coincided accurately with the thermometric measurements, whence it must be presumed that the temperature of this spring is lower than the mean atmospheric temperature, especially as the spring had its source on a higher point of the peak. From this point Humboldt ascended constantly without passing a single valley, and crossing only the little clefts, like folds in a mantle, surrounding the volcano. The points which, from the island, seem separate volcanic mountains, such as Chahorra, La Urea, &c., Humboldt found to be little hills leaning against the peak, and

hiding its pyramidical form. Through the heath district Humboldt ascended into the region of ferns, where the root of one very plentiful kind serves as food to the inhabitants of Palma and Zomera; then he came to a wood of juniper and fir trees, and at last to a plain, like a large green sea, covered with ferns, and which it took the travellers two hours and a half to cross. In addition to this they suffered from the very great heat, which was reflected from the soil. The plain, formed of pumice-stone, is covered with the beautiful, odorous, flowering Retema plant, sometimes nine feet high, with which the passing hunters decorate themselves, and which serves the goats of the peak as nourishment. These goats live here wild, have a dark brown skin, and are eaten as a delicacy. As soon as Humboldt arrived on this pumice-stone plain, he saw that the character of the landscape, which had been so fertile hitherto, was entirely changed; at every step he came upon immense volcanic productions; everything announced a quiet, deep solitude of a deserted district, which extended over ten square miles of desolation. From here the island seemed like a colossal heap of burnt matter, round which the vegetable world had formed a small border. Through narrow and deep clefts, hollowed out by the former mountain-streams of olden times, Humboldt came to a mountain level, El monton de Frigo, and from there, at a height of 9312 feet, to a station, Estancia de los Inglesos, where he and his companions had to pass the first night.

Humboldt's dwelling for the night was a cavern, which protected him from wind and weather; the guides lighted a fire of dried branches, and lay down, without tents or cloaks, upon a heap of burnt stones, where the fire, smoke, and wind, were very troublesome. They tried to make a screen of handkerchiefs tied together, but the fire caught and consumed a portion of it before the travellers perceived it. Humboldt had never passed a night at such an elevation above the sea, and did not then imagine that he would

some day visit towns on the ridge of the Cordilleras, higher than the peak of Teneriffe, which he hoped to reach next day.

As the cold increased, clouds lowered round the peak, and, although the north wind drove them furiously away, new ones were always gathering, and the moon, with a peculiarly blue disk, sometimes peeped through clouds and mist. Gradually the point of the volcano shrouded itself in thick mist, which suddenly again separating, showed the large pyramid of the peak in threatening vicinity, casting its tremendous shadow on the lower clouds.

At three o'clock in the morning Humboldt and his companions started on the way to Piton, the guides faintly lighting the road with dim pine torches. In two hours they reached a plain called the station of the natives, where the people rest who fetch ice and snow to sell in the neighbouring towns. There is a so-called ice cave here 1732 toises (10,392 feet) high, so situated that the rays of the sun cannot enter it to melt the ice and snow which accumulates during the winter. Humboldt and his companions left this ice cave with the morning twilight, and struggled on through the broken lava, having often to use their hands for climbing. Here an atmospheric phenomenon surprised them—they seemed to see rockets rising in the east, the guides had never seen this before, and anticipated an approaching eruption of the volcano, when Humboldt perceived that the apparently floating sparks were the reflections of stars which mirrored themselves in the moving mist. The journey was now continued through the so-called Malpay, and became extremely fatiguing and difficult, for the lava has not only very sharp edges and forms caves of several feet deep, but also frequently breaks off and rolls down. The indolence and ill-will of the guides made the ascent more difficult still, for they did not wish to go any further, sat down every ten minutes to rest, secretly threw away the minerals which Humboldt and Bonpland had carefully col-

lected, and it even appeared that none of them had ever been on the summit of the volcano. In spite of these disadvantages, Humboldt perseveringly followed the path for three hours, when they arrived at a little plain in whose centre the Piton or Sugarloaf rises, and where the outlets of the peak are, which the natives call nostrils, and from which vapours sometimes rise which have no smell and seem to consist of pure water.

The steepest part of the mountain had to be climbed now, and the ascent could only be achieved by following the remains of an old stream of lava which formed a kind of rocky wall in the midst of the rolling ashes. After climbing with hands and feet up the sharp pointed lava mass, they ascended the Sugarloaf. In about half an hour they had surmounted the cone, about ninety toises high, and the way would have been more dangerous still had the so-called Sugarloaf been covered with snow. Humboldt was shown the spot on which Captain Baudin had once nearly lost his life.*

At eight o'clock in the morning, in a freezing temperature, Humboldt reached the top of the cone, which scarcely afforded sufficient room for the whole party to sit down to rest. They could not see the crater itself, because lava and brimstone had formed a kind of wall round it. An opening on the western side, probably formed by a stream of lava, afforded an entrance into the kettle of the volcano; Humboldt, followed by his companions, descended to the bottom of the funnel, whose eggshaped mouth must be 300 feet in length, and 200 broad. The warmth they perceived here proceeded from some slits from which watery vapours flowed, accompanied by a peculiar rushing sound, and the interior of this crater afforded the picture of a volcano which has for millenniums

* Captain Baudin had been bold enough to ascend to the summit during the snowtime in 1797. When he had got about half way, he slipped, and rolled down to the next plain, where, fortunately for him, his fall was broken by a heap of lava covered with snow.

ejected fire only from its sides. Without further danger Humboldt and his companions reached the bottom of the funnel-shaped crater, whose depth may be about 110 feet, and which, like all extinct volcanoes, seems to have changed little for centuries. Indeed, the majestic effect of the deep ravine seemed to Humboldt to consist more in its height above the level of the sea, in the desolation of this elevated spot, which must be 11,500 feet high, and in the extensive prospect which the summit of the mountain affords. Humboldt says, "experience has taught us that the tops of the highest mountains rarely offer such fine prospects as the less high summits of Vesuvius, the Rigi, and the Puy de Dôme. But the peak of Teneriffe unites by its slender form and its locality all the advantages which less high mountains possess; from its summit is seen not only an immense expanse of ocean, but also the forests of Teneriffe, and the inhabited portion of the coast, in such vicinity as is adapted to produce the finest contrasts of form and colour. As we were sitting on the extreme edge of the crater we directed our attention to the north-west, where the coast is studded with villages and hamlets. Below us the mass of exhalations driven by the wind formed the most varied pictures. A monotonous layer of clouds had been separated on several points, by currents of air which the heated earth sent up from below. The town and port of Orotava, with its gardens, vineyards and ships, lay before us. From the height of these solitary regions our eyes fell on an inhabited world; we had the contrast between the smiling appearance of cultivated plains and the barren sides of the peak, the steep precipices covered with loose stones, and the plains without a trace of vegetation. We saw the plants ranged in zones, according as the warmth of the atmosphere decreases with the ascent."

The extreme transparency of the atmosphere permitted the travellers not only to distinguish villages, vineyards and gardens, from the top of the peak, but

even single houses, the sails of ships, and the trunks of trees; but the stay at this considerable height had nevertheless become very unpleasant, in consequence of the cold, which was severe in spite of the season, (June), for the thermometer had fallen to two degrees (Celsius), and a violent west wind forced the travellers to seek shelter at the foot of the Sugar-loaf. Face and hands were numbed with the cold, while their boots were burnt by the hot soil on which they stood. They commenced the retreat; the Sugar-loaf, climbed with such difficulty, was deserted in a few minutes, although the descent had to be cautiously made, on account of the moveable lava and slippery ground. They first reached the plain of the retema plants, at a temperature of 22½ degrees, which seemed a suffocating heat after the cold of the summit, and then entered gradually the refreshing temperature of ferns and bushy heaths.

Towards evening they arrived again in Orotava.

THE LLANOS.

It has been mentioned in former chapters that Alexander von Humboldt suffered great hardships in traversing the "Llanos" (the treeless, immense plains of southern America). In order to give our readers an idea of these expeditions, we append a sketch, made by Humboldt of the nature of these steppes.

"Solitary huts, made of moss and branches, and covered with bulls' hides, lie at a day's journey from each other. Innumerable herds of wild bulls, horses, and mules, roam about the steppes. Primeval forests and impenetrable darkness, prevail on the narrow damp boundary which surrounds the desert, mighty granite rocks narrow the bed of the foaming rivers. The wood resounds with the thunder of the rushing waters, with the roaring of the jaguar and the dull howling of the monkeys. Where the shallow stream has left a sand-bank, there the heavy bulk of the

crocodile lies with open jaws, immovable like a rock, sometimes perched on by birds. With its tail coiled round the stem of a tree, the tiger-spotted boa lies watching on the shore, sure of its prey. Darting suddenly forward, it seizes at a bound the young bull or the weaker game, and forces its prey, coated with slime, down its swelling throat. But when, beneath the horizontal rays of the never-clouded sun, the burnt-up grass has fallen into dust, then the parched soil gapes as if it were agitated by tremendous earthquakes. Like roaring waterspouts, contrary gusts of dust-clouds rise eddying funnel-shaped; a dull straw-coloured demilight shines over the desolated ground from the apparently lowering sky; the horizon diminishes, the steppe shrinks, like the traveller's courage. The hot dust which floats in the misty veiled atmosphere increases the oppressive, ill-odoured heat.

While the animals in the icy north are frozen by the cold, the crocodile and the boa slumber here motionless, buried deep in the soil. The drought brings death to all; and the deceitful mirage of the waving water pursues the thirsting. Enveloped in thick clouds of dust, and tormented by a burning thirst, the horses and bulls wander about, the latter roaring loudly in their anguish, the former snuffing the wind with outstretched nostrils, to discover the vicinity of a not entirely-evaporated ditch in the moisture of the breeze. And, even when the coolness of the long night succeeds the burning heat of the day, the horses and herds cannot enjoy a moment of repose. Immense bats, vampire-like, suck their blood while they sleep, and claw themselves on to their backs, where they produce festering sores, in which a host of stinging insects house. When, after the long drought, the beneficent rainy season commences, the scene is suddenly changed; the deep blue of the unclouded sky grows paler, and at night one scarcely perceives the faint space in the sign of the southern cross. The gentle phosphorescent glimmer of the Magellan clouds is extinguished, and even the signs of the Eagle and

the Serpent-bearer which stand over head, shine with a tremulous light. Like distant mountains, single clouds appear in the south, the mists spread like fogs over the zenith, and distant thunder announces the refreshing rain. Scarcely has the surface of the earth been moistened, when the fragrant steppe is covered with the most varied grasses. Attracted by the light, low plants unfold their slumbering leaves and greet the rising sun, together with the song of birds, and the opening buds of the water-plants. Horses and cattle graze in the full enjoyment of life. The beautifully-spotted jaguar hides in the high grass, and, cat-like, springs to catch the passing animals. Sometimes one sees the damp clay on the shores of the morasses rise slowly and by pieces, with a violent noise like the eruption of little slime volcanoes, the earth is thrown high in the air; . . they who are familiar with this phenomenon fly from the spot, for a gigantic water-serpent, or a thick-skinned crocodile rises from the cavity, awaked from the simulated death by the showers of rain. As the rivers gradually swell, nature forces the same animals which were perishing with thirst for the first half of the year on the waterless dusty soil, to live now as amphibious animals; a portion of the steppes seems like a vast inland sea. The mares retire with their foals to the higher banks, which project like islands from the surface of the water. The dry space decreases day by day. The crowded animals swim about for hours in search of pasture, and find a sparing subsistence from the rich grass which rises above the brown-coloured fermenting water. Many foals are drowned, many are caught by the crocodiles, killed by a blow from their jagged tails, and then devoured; one often sees horses and cattle which have escaped the claws of these voracious animals, and bear the traces of their sharp teeth in their thighs.

But as crocodiles and tigers here fight against horses and cattle, we also see man opposed to man in various parts of these deserts. With unnatural blood-

thirstiness, they drink the blood of their enemy, or murder him when apparently unarmed, with a poisoned thumbnail. The weaker tribes of men carefully conceal with their hands the trace of their timid footpaths from their stronger enemies. Thus man, on the lowest stage of savage barbarism, as in the apparent splendour of civilization, always makes his life wearisome; and the same desolating picture of the hostilely-divided human race pursues the wanderer over land and sea, and the historian through all centuries. Therefore, he who longs for mental repose in the endless quarrel of nations, directs his attention to the calm life of plants, and the secret workings of holy nature; or, confiding in the inborn instinct which for centuries has glowed in the heart of man, he looks hopefully up to the high stars, which pursue their old eternal course in undisturbed harmony."

ASCENT OF THE SILLA OF CARACAS.

It was difficult to find a guide to the mountain; the hunters do not go so high, and Humboldt's intention of collecting plants, breaking off stones, and instituting barometric and thermometric observations, were things unknown here. By the intervention of the governor, some negroes were appointed to guide him. As it was the season in which two fine days rarely succeed each other, Humboldt determined to start on his journey on a day when the clouds would have lowered, and an approaching clearer atmosphere might be anticipated. The mountain ascent was commenced on the 22nd January by a company of eighteen persons, who rested for the night in a coffee plantation near a precipice. The night was very clear, and they made use of it for astronomic observations. At five o'clock in the morning, the company started again on the narrow pathway, followed by slaves who carried the instruments. They reached the promontory of Silla, called by the shep-

herds, Puerta de Silla, at about seven o'clock. The morning was fine and cool, the sky seemed to favour the undertaking, and the view was most picturesque. The guides hoped to reach the Silla heights in six hours. The noise of the waterfalls was heard, but the mountain stream could not be seen, for it was concealed beneath the thick shadows of the erythrias, clusias, and Indian fig-trees. Nothing could be more beautiful on a spot where there are so many plants with large, bright, and tough leaves, as the view down on the tops of the trees, illuminated by nearly perpendicular rays of the sun.

The way became steeper and more fatiguing; the ground was covered with short grass, which afforded no firm footing, and it was impossible to leave any footmarks in the grass. Thin vapours rose from the forests, and announced an approaching mist. They accumulated and ranged themselves as cloudy curls round the two tops of the Silla, as the forerunners of a still denser mist. Humboldt's companions lost courage, and showed some signs of beating a retreat, and the intimate garrulity of the accompanying negro creoles contrasted strongly with the solemnity of the Indians, who had been Humboldt's guides in the missions of Caripe. They mocked the discouraged guides, and made themselves merry especially at a young Capucin friar, who was, at the same time, professor of mathematics. When the travellers started, he thought, as all Europeans do, that he would surpass all the Americans in boldness, strength, and foresight; he had even taken bits of white paper with him, that he, as the foremost of the climbers, might throw them down from time to time to show the way to the less agile. He had boasted much of his boldness and perseverance, and had promised the monks of his order to fire some rockets from the top of the mountain, in order to announce to the inhabitants of Caracas an event the importance of which he alone could appreciate. But this boaster lost courage long before the creoles did, and remained all day in a neighbour-

ing plantation, whence he watched with a telescope how far Humboldt and the others would be able to climb.

The expedition moved on towards the eastern highest points of the Silla, which terminates in two round points. From the foot of the waterfall Chacaike to a height of 6000 feet, they found only cow-pastures, with two small lily-like plants with yellow flowers, and some brambles. Humboldt searched in vain for a wild rose, of which, indeed, he could only find one specimen in South America. Their journey now became very arduous on account of the fog, and because in climbing the steep and slippery ascent they had to make use of their hands as well as their feet. At a height of more than 5500 feet, the sight of a palm forest in a mountain pass formed a surprising contrast to the pastures in the valley; nowhere did Humboldt find such a variety of plants on so comparatively small a space, as in this palm forest of Pejoal, whose most interesting feature was a bush from 10 to 15 feet high, of the family of the umbelliferous flowers, which the creoles called incense (incienso). While Humboldt was examining the flowers, the sky grew darker and darker, the thermometer sank below eleven degrees, which, in the torrid zone, causes an unpleasant degree of cold. Through groups of Alpine plants—so called by Humboldt—they again came to a pasture-field (savannah), and climbed over a portion of the western point, to descend into a cleft between the two summits, called the saddle. The luxurious vegetation here made it extremely difficult to find a path, which had to be hewn with knives and axes. From time to time the clouds separated, and the travellers then saw the eastern point of the mountain, but then a dense mist suddenly again obscured the view. At every step the danger was incurred of coming upon the ledge of the tremendous precipice, and falling down 6000 feet into the sea. A halt was made, the negroes soon arrived with victuals, but the meal was very sparing, as they had only olives and a

little bread. Even the guides had lost all courage, and Humboldt had great trouble to prevent their returning.

It was two o'clock in the afternoon, and Humboldt was in hopes of reaching the eastern point before sunset, and returning early enough to rest the night in the valley between the two points. He had sent back half of his attendants, with the order to meet him on the following day, with salt meat and refreshing victuals, instead of olives. Scarcely had these preparations been made, when the east wind arose, and dispersed the clouds in less than two minutes. The two points of the Silla covered only with grass and low Befaria bushes, seemed astonishingly near. Humboldt explains the absence of high trees on the two points of the Silla, (the tree boundary in this zone being really 2400 feet higher), by the barrenness of the soil, the violence of the sea winds, and the frequent spontaneous conflagrations in this region.

In order to reach the highest eastern point, they had to approach the extremely steep precipice hanging over the sea, and the obstacles which the luxurious vegetation had hitherto opposed to their progress decreased as the travellers approached the point. In three quarters of an hour they had reached the point of the eastern pyramid, and stood 8100 feet above the sea. The prospect to the north over the ocean, to the south over the fertile plain of Caracas in a circumference of nearly thirty miles, was surprisingly beautiful. But the open view from this steep precipice, whence one can see, (though not the town of Caracas, which was concealed by the western pyramid,) a beautiful group of villages, coffee plantations, and the course of the river Rio Guayra, did not last long. Mists again obscured it, and a swarm of bee-like animals attacked the travellers. It would have been rash to have tarried near the deep precipice in this dense fog, and the retreat was commenced to the saddle, the space which divides the two points. At half-past four, Humboldt had finished his scientific observations,

and, pleased with the fortunate result of this ascent, the idea of spending the night in the saddle valley was given up. Having found the path they had hewn at the ascent, they soon descended into the palm forest of Pejoal. The night, which quickly succeeded the short twilight, overtook Humboldt and Bonpland botanizing; the moon, sometimes obscured by clouds, shone in the sky; the guides who carried the instruments, went away, one by one, to seek a sleeping place between the rocks, and Humboldt and Bonpland, overwhelmed with weariness and thirst, arrived at ten o'clock in the lower valley, by a wearisome path. After a descent of six hours, the company again arrived at the farm at the foot of the mountain. They had been watched on the summit by telescopes in the town.

THE COMBAT WITH ELECTRIC EELS.

The marshes and standing waters near Calabozo are filled with electric eels. Humboldt and Bonpland wished to make experiments in their own house with these animals, but for three days they could meet with no specimen, on account of the exaggerated fears of the people for the electric effects of these animals. Tired of waiting, and as the eel which was at last brought to them offered no satisfactory results to their experiments, Humboldt determined to go himself to this dreaded and dangerous capture. The Indians thereupon took him and Bonpland to a large reservoir of slimy water, surrounded by odorous plants, near the village of Rastro de Abazo; but it was difficult to catch the electric eels with common fishing nets, as they bury themselves with great agility in the slime. They did not wish to make use of the Barbasco root, which, thrown into the water, would have stupified all the fish in it.

The Indians now declared they would fish with horses, and not until the guides had caught a quantity of wild horses and mules, and forced them to enter

the ditch, could Humboldt and his friends form any idea of this mode of fishing. The noise occasioned by the stamping of the horses, drives the eels out of the slime, and irritates them; they swim on the surface of the water, and press themselves against the belly of the mules and horses. A strange combat now begins; the Indians, provided with long thin bamboo canes, encircle the ditch: some climb the trees, whose branches extend horizontally over the water. By wild screams and threats with their long canes, they prevent the horses coming ashore and escaping. The eels, terrified by the noise, defend themselves by the repeated discharge of their electric forces. It seems, for a time, as if they would carry off the victory over the horses, for many of the latter succumb to the force of the invisible electric blows, which the eels give on the belly, the most sensitive part, and they sink below the surface, overcome by the quantity and violence of the shocks. With bristling mane, snorting, with wild terror in their sparkling eyes, some horses rise again, and endeavour to escape, but the Indians drive them back, and but few escape the eyes of the watchful guards. If such an one, escaping from the shocks of the electric eels, reaches the land, it falls at every step, and sinks down on the sand, faint and exhausted.

In the first five minutes two horses were already drowned. The eel, which is five feet long, presses against the belly of the horses, and discharges its electricity along its whole length, which stuns the abdomen, entrails, and heart of the horse. The horse sinks down exhausted, and is drowned, because the continuing struggle of the eels with the other horses prevents its rising again.

Humboldt was already anticipating that this fishing would end in the death of all the horses, when the violence of the unequal struggle gradually abated, and the exhausted electric eels dispersed; for they require long rest and abundant nourishment to regain the strength spent by the frequent discharge of their electric organs. The horses and mules recovered from their

terror, their manes no longer bristled, and their eyes no longer glared so fearfully. The Indians maintained that if the horses were driven into the water of electric eels on two consecutive days, none would die the second day. The eels now timidly approached the shore, where they were caught with little harpoons attached to long ropes. If the ropes were perfectly dry, no electricity was felt while hauling out the fish, but it was communicated through the wet ropes. In a few minutes five large eels were caught which were only slightly wounded, and others were caught in the evening in a similar manner. This was the wonderful combat of the fishes and the horses: and Humboldt adds: that power which is the invisible living defence of these water inhabitants; which is developed by the motion of moist or unequal parts; which circulates in all organs of animals and plants; which thunderingly inflames the expanse of heaven; which unites iron to iron, and guides the calm, revolving course of the needle; all this, like the colour of the prismatic ray, flows from one source—all is resolved into one eternal universal force.

TROPIC STORMS.

The impression which a tropic storm makes upon a European, a stranger to this zone, is very imposing; the phenomena of the atmosphere are not accidental, but succeed each other in the equinoctial regions with a wonderful uniformity.

Nothing can equal the pureness of the atmosphere from December to February. The sky is always cloudless; and if a cloud appears, it is a remarkable phenomenon. The eastern and east-north-eastern breeze blows violently, and as the atmosphere it brings is of a uniform temperature, the mist cannot become visible by refrigeration.

Towards the end of February, or the beginning of March, the sky is coloured of a darker blue, the

hygrometer shows a gradually increasing moisture, the stars are sometimes veiled by a slight mist, their light is not steady, and they are occasionally seen to sparkle about twenty degrees above the horizon. The breeze blows less violently, and there is often a total wind calmness. South-south-east of the horizon the clouds gather, they seem like distant mountains with inaccurately defined outlines; they are sometimes seen to quit the horizon, and scud through the sky with a speed quite inconsistent with the weakness of the wind in the lower atmosphere.

Towards the end of March, the southern region of the atmosphere is lighted by small electric explosions; they are phosphorescent sparks, limited to a single group of mist. Now, from time to time, south-west winds occur, lasting some hours, and are the sure signs of the approach of the rainy season, which begins towards the end of April in the Orinocco district.

The sky then begins to be clouded, the clear blue disappears, and a uniform grey colour takes its place. At the same time, the warmth of the atmosphere increases, and not only clouds, but dense mists, cover the vault of heaven. The howling monkeys make themselves heard several hours before break of day; the atmospheric electricity, which, during the dry season from December to March, had nearly always averaged 1·72 lines of the voltaic electrometer during the day, becomes extremely variable, being sometimes 0, sometimes 3.4 lines.

The rainy season is also the season of thunder-storms. The storm commences two hours after the passage of the sun through the meridian, a short time after the period when the heat has reached its maximum. The thunder is rarely heard in the night or in the morning; but these thunder-storms are altogether only confined to certain river districts having a peculiar climate.

VOYAGE ON THE APURE.

On account of the monotony of the steppes, Humboldt preferred to sail into the Orinocco on the river Apure. He hired for the purpose a broad vessel called a piroge, which was navigated by a steersman and four Indians. The Apure harbours many fish, sea cows, and tortoises, and its shores swarm with birds; the river grows gradually broader, the shore on one side is sandy and barren, on the other grown with high stemmed trees. Humboldt was now in a territory little known by man, and exclusively inhabited by tigers, crocodiles, and chiguires. Sometimes the stream was bordered by woods on both sides; these woods commenced with bushes of sanso, which forms a hedge four feet high, and behind them grew a kind of paternoster or Nicaragua wood. Tigers, tapirs, and pecaris had broken passages through the hedge to come to water at the stream. Where the flat shore is rather broader, and the sanso hedges grow a little farther from the water, the space between serves as a resting-place for the crocodiles, and eight or ten were frequently seen lying immovably on the sand, with their open jaws extended. The journey had scarcely begun, and Humboldt knew that many hundreds more would lie in the slime of the savannahs! Besides this, the Indian rowers assured him that a year rarely elapsed in which two or three grown up people, generally women, coming to draw water at the stream, did not fall a sacrifice to the crocodiles. In these deserts, says Humboldt, where man lives in constant strife with nature, the conversation turns much on the means by which one can escape the pursuit of a tiger, a boa or a crocodile; every one prepares to meet the threatening dangers. The crocodile lets loose its prey if one presses its eyes with the fingers, and a young girl had lately escaped from the grasp of the animal at San Fernando by this means, with the loss only of the forearm, which it had bitten off. The

crocodile of the Apure is quick and sudden in attack, and makes a curious noise as it runs, which seems to proceed from its scales beating against each other. They run straightforwards, but they can turn very well; Humboldt often saw young ones biting their own tail. Only when swimming against the stream it finds a difficulty in turning, and the large dog which accompanied Humboldt escaped from a crocodile by quickly turning round against the stream.

Near Joval, where the country grows more and more wild, Humboldt saw a large tiger lying in the shadow of a zamang, one of its paws resting on a just caught chiguire (about the size of our pigs). The zamures (a kind of vulture) had approached to share the remnants of the feast, and came to within two feet of the tiger, but the least movement sent them terrified away. When the boat of the travellers approached, the animal hid behind the sanso bushes, and the vultures tried to seize the opportunity to devour the chiguire, but the tiger, in spite of the vicinity of the boat, leaped among them and carried his prey off into the wood.

Lower down the stream they saw a whole herd of chiguires from which the tiger had probably taken his victim; they did not seem to fear human beings, but ran away and dispersed at sight of the large dog which accompanied the travellers; so slowly did they run, however, that two of them were caught.

Humboldt and his companions spent the night, as usual, in the open air. The next morning, on the 1st April, they passed a flat island below Joval which was inhabited by innumerable flamingoes, spoonbills, fish-bills, and waterfowl. The next night the travellers spent on the barren shores below Vuelto del Cochino, and the thick forest was so impenetrable, that there was scarcely sufficient dry wood to be obtained for the Indians to make a fire as a protection against the tigers. The night was calm, clear, and moonlight, the crocodiles were lying on the shore looking towards the fire, whose brilliancy seems to attract them as

much as fishes and crabs. The Indians found the traces of three tigers in the sand, of which two seemed to have been very young; Humboldt supposed that it was a female tiger who had brought her young to water.

For want of trees the oars were fastened in the ground, and the hammocks swung to them. All was quiet until eleven o'clock in the night, but then such a fearful noise arose in the neighbouring wood that sleep was impossible. Of the number of voices of wild animals which sounded at the same time, the Indians, who were with Humboldt, distinguished only those separately audible, such as the low flute-like tones of the sapajo, the sighs of the alonates, the scream of the tiger, the conguar, the muskrat, the sloth, the hocco, the parragua, and some other fowls. As soon as the jaguars approached the boundaries of the forest, Humboldt's dog howled and crept beneath the hammocks. Sometimes, after a long pause, the tiger's voice was heard from the trees, followed by the sharp continuous scream of the monkeys escaping from the danger.

The security which the Indians seemed to feel inspired Humboldt and his friend Bonpland with courage. They listened to the accounts how all tigers dread fire, and never attack a man lying on his hammock, and the case is indeed very rare. The noise which the animals make, seems to arise from a quarrel among them. The jaguars pursue the pekaris and tapirs, who fly in crowded herds. The monkeys, startled by the noise, respond to the cry from their trees, and thus the inhabitants of the forest are awakened one after the other, and the whole menagerie is in an uproar.

The next morning (April 2nd) Humboldt went on board his ship again, the river being crowded by quantities of porpoises. At noon the travellers halted in a desolate spot. Humboldt relates:—"While the boat was dragged ashore, I had separated from the company, and was walking along the banks to watch

a group of crocodiles. The animals slept in the sun, and were so lying that their broad scaly tails rested against each other. Little snow-white herons perched on their heads and backs, as if they had been trunks of trees. I had been looking only towards the shore, when, on lifting up some scales of mica, abounding in the sand here, I perceived the fresh footprints of a tiger, and, at eighty paces distant, saw an immensely large jaguar lying beneath the foliage of a ceiba tree. There are circumstances in life when it is impossible to reason. I was much alarmed, but had self-possession enough to proceed onwards without running, and to avoid any movement of the arms. I perceived that the jaguar was fixing its attention exclusively on a swimming herd of capybaras, I therefore commenced my retreat in a long round towards the shore, gradually hastening my steps. How often was I tempted to look back to see if I was pursued! Fortunately I did not do so till late, and then saw that the animal had remained immovable. The wild beasts here are so well fed that they rarely attack men. I arrived breathless at the vessel, but the Indians to whom I told my adventure treated it with great indifference. However, when they had loaded their guns, they accompanied me and Bonpland to the spot where I had seen the tiger. We did not find him there, and did not deem it advisable to pursue him into the wood."

The next night, Humboldt and his companions again spent on the shore, opposite the island Conserva. The lighted fires again attracted the crocodiles, and a female jaguar approached the river to water its young. The 4th April was the last day spent on the Apure. The insects began to torment dreadfully, especially the zancudos, whose proboscis is so long that it penetrates through hammock and garments. The next day Humboldt's vessel, after safely avoiding the shallows caused by the long drought, gaily entered the long desired Orinocco.

SCENES FROM THE ORINOCCO VOYAGE.

Humboldt landed upon an island which is celebrated in the country for its turtle fisheries, and which the mission Uruana considers as its property. There was a company of above three hundred persons of several Indian tribes congregated here, who slept beneath huts of palm leaves, each tribe on separate encampments. There were also some white people, merchants from Angostura, who came to purchase the oil of the tortoise eggs from the natives.

Humboldt and his companions seemed suspicious characters to the missionary, and the object of their journey very mysterious.

"Who will believe," he said, "that you have left your country to be consumed here by mosquitoes, merely to measure lands which do not belong to you."

Humboldt could only satisfy his doubts by the recommendation of a father guardian of a Franciscan convent, and by the presence of the brother-in-law of the Statthalter of Varinas, who had accompanied him on the journey on the Orinocco.

Here Humboldt saw the manner of the tortoise catching. The great Arran tortoise lays its eggs at the time of the lowest water, always beginning at night, immediately after sunset. The animal digs a pit two feet deep and three feet broad, whose sides it is said to cement with its urine. The impulse to lay its eggs is so urgent, that some tortoises make use of the holes which others have dug but not filled up again, and lay a second layer of eggs over the first. The number of the tortoises labouring on the shore is so great, that morning sometimes surprises them at their incompleted work. But although they move away quickly, they can easily be caught by hand. The egg gatherers investigate the situation and extent of the egg deposits with a long pole. When the pole is pressed perpendicularly into the soil, the suddenly ceasing resistance reveals the soft soil on which the eggs lie. The eggs are gathered with a metho-

dical regularity. According to the number of Indian tribes, the soil is divided into certain districts, for the deposits of eggs are found three feet deep, 120 feet from the shore. When they have sounded with the poles, the Indians dig up the soil with their hands, and break the eggs into wooden troughs filled with water, and expose them to the rays of the sun until the yellow, upper, oily part thickens. This oil is then boiled separately, and if none of the eggs contained embryo tortoises, it is very pure and of an agreeable flavour. A space on the shore 120 feet long and thirty feet broad, gives 100 ships' jars full of oil (from 1000 to 1200 cubic inches) and 5000 eggs are required to make one jar full. But as one tortoise lays at the utmost from 100 to 116 eggs, and about one-third are destroyed before they can be collected, 330,000 tortoises are required to produce the thirty-three millions of eggs which afford the above quantity of oil.

Where the Orinocco suddenly turns northward near San Fernando, it breaks through a portion of the mountain ridge. Here are situated the great waterfalls of Atures and Maypuros, and here the bed of the river is narrowed in by immense masses of rock. The stream surges along the eastern precipices; an extensive grass plain extends between the two hills, the rocks Kari and Oco, which rise like mountain-fastnesses from the old river bed of the bay, which was once filled by the Orinocco like a sea, and presented a magnificent prospect. The northern end of the waterfalls is characteristically called the sun and the moon in the language of the aborigines. The rock Kari has its name from a luminous white spot, in which the Indians perceive a remarkable similarity to the moon. Humboldt was not able to climb the steep rock, but supposed the white spot to be an immense piece of quartz in the dark granite. Opposite the Kari rock, on the basaltic twin rock of the island of Quivitari, the Indians show with secret admiration a similar disk, Camosi, which they worship as the

image of the sun. The geographical situation of the rocks may have contributed to their naming, for the Kari stands westward, the Camosi eastward. The waterfalls of Maypuros do not consist, like the cataract of Niagara, in the single fall of an immense volume of water, nor of narrow passes through which the stream flows with increased velocity, like the Pongo of Manseriche in the Amazon, but it presents a countless number of small cascades which rise, ladder like, above each other, and are formed of a real archipelago of little islands and rocks, which often lie so thickly together on the eight thousand feet broad bed of the river, that scarcely twenty feet of navigable water is left. Every rock or step is from 2 to 3 feet high, the most notoriously dangerous, called Purimaximi and Manimi, are nine feet high, and yet the Indians venture to ride down the stream through the waterfalls in a slight boat, and when they go up the stream they swim in advance, throw a rope with infinite dexterity round a rock projecting from the surge, and then draw up the vessel, which is generally filled with water or turned over. The boat is often dashed to pieces on the rocks, and the boatmen then endeavour to save their bleeding bodies from the waves by reaching the nearest shore. As the real fall of water, according to Humboldt's measurement, is only from 28 to 30 feet, the dreadful noise and wild tossing of the waves is not the consequence of the fall, but of the counter-current, which is caused by the form and position of the rocks.

As Humboldt was descending to the bed of the river over the rock Manimi, he enjoyed a splendid view over a foaming surface miles long, from which black rocks projected. Every rock, every islet rising above the water's surface, was ornamented with luxurious high forest trees, and a dense mist floats eternally over the falls. Through the cloud of foam the point of the palm trees is seen, and when the ardent evening sun was reflected in the moist mist, it presented an optical painting like an ethereal picture, in

the splendidly-coloured rainbows which were formed and vanished again in varying succession. The water during the long rainy season, has washed earth on to the bare rocks which project, and on which now various plants, especially silver-leaved mimosa and drosera grow. In the distance the eye rests on the long mountain chain Cunarami, which terminates suddenly in a blunt cone shining with a red light in the setting sun.

It surprised Humboldt that the noise of the current was three times stronger in the night than by day, a feature, by the way, peculiar to all European waterfalls. But in a desert, where the quietness of day is never interrupted, and is equal to that of night, another reason than this contrast must be discovered, and Humboldt believes that the warm air of the day does not conduct the waves of sound so well as the nocturnal cold air, on account of the unequal elasticity.

Humboldt, and his friend Bonpland, ventured to pass the last half of the waterfall of Atures, also, with the laden boat. The two bold travellers first landed several times on the rocks which connect the single islands in the current-like dykes; sometimes the waves dashed over these dykes, sometimes they fell with a dull sound into their basin, and found an outlet through subterranean canals, while the golden rock hen nestled on the dry rocks. The two travellers crept into one of these caves, lying under the rocky dykes; its damp walls were covered with confervas and luminous bissuth, and over their heads the torrent rushed with a fearful noise. As the Indians had left them in the middle of the waterfall to circumnavigate a small island in their boat, and were to take them up again at the lower point of the island, they were obliged to spend an hour and a half on this rock in a dreadful storm. The night had already commenced to set in, and they in vain sought shelter from the rain under the cleft granite. The little monkeys, which they had carried on their wanderings for

months in wicker baskets, attracted the crocodiles by their screams, and thereby refuted the assertion of the Indians that crocodiles had never been seen in the cataracts, confiding in which assertion Humboldt and Bonpland had even several times ventured to bathe.

The storm increased; wet through and stunned by the thunders of the cataract, they waited anxiously for the arrival of the Indians with the boat. At last, they came, having sought for navigable water for a long time.

Humboldt now visited the notorious cave of Ataruipe, situated at the southern entrance of the waterfall of Atures. Not without risk of falling, did Humboldt and his friend climb the steep wall of granite, and they would not have found a footing on the smooth surface, if large crystals of feldspar had not projected from the rock. But they were rewarded with a splendid view at the summit; before them was the shining water, from which fertile hillocks projected, and westwards, beyond the river, immeasurable fields of verdure. But in the immediate neighbourhood everything was bare and narrow, and the vulture and the screeching goat-sucker soared solitary over the deep valley. The back ground of this rocky valley is overgrown with close bushes, and in this shaded part lies the notorious cave, the grave of an extinct nation. The travellers counted above 600 well-preserved skeletons, which were lying in square baskets, made of the stalks of palm leaves, and of which, neither rib, hand, nor foot-bone was missing. Near the skeletons stood urns about 3 feet high and 5½ broad, made of half-burnt clay, with crocodile or serpent-shaped handles, and these urns seemed to contain bones of entire families. Most of the skeletons did not seem above 100 years old, and the tradition in this neighbourhood is, that the brave Aturians, pursued by the cannibal Caraibes, had fled to the rocks of these waterfalls, and had perished here. . . Humboldt left this cave at night, taking with him

several skulls and one complete skeleton.* They parted in solemn silence from this mysterious cemetery; it was a fine and cool night, the moon, surrounded by coloured rings, stood high in the air, and illuminated the mist which, cloud-like covered the surging river. Innumerable insects radiated a reddish phosphorescent light over the plants, which glowed with living fire. Climbing bignonias, odorous vanillas, and golden banistorias, ornamented the entrance to the cave,—over the dead the summits of the palm trees rustled.

The catholic missionary of San Fernando had brought his Indians to the shores of the Guaviare, on a hostile expedition, which was, in reality, a chase of human beings, equally opposed to the laws of religion and humanity, and to those of the Spanish government. On this unchristian expedition, a mother with three children, of which two were yet infants, were found in an Indian hut. They were occupied in the preparation of Manioke flour; the father was fishing, and could, therefore, not defend his family from the hostile man-hunters and Christian oppressors. The mother endeavoured to escape with her children, but had scarcely reached the savannah when she was overtaken by the man-hunters of the mission, she and her children pinioned and dragged to the shore. The missionary was watching the success of the enterprise from his boat. If the mother had made a violent resistance, she would have been cut down by the kidnappers, for everything is permitted in the missions, when they go out "soul catching." They always prefer to take children and rear them as slaves to the Christians.

The mother was brought to San Fernando with her children; they hoped she would not be able to find

* Blumenbach subsequently cast one of these skulls, but the skeleton was lost in the before-mentioned shipwreck.

her way back to her home by land. But her maternal heart longed for those children, who had accompanied the father on the day she was carried off. In despair she, with her children, made several attempts at flight, but was overtaken, mercilessly whipped, and, at last, separated from her two infants. She was taken up the river Atabo into the missions of Rio Negro. Loosely bound, and not knowing what fate awaited her, she sat in the forepart of the vessel. She succeeded in breaking her bonds, sprang into the water, and swam towards the left shore: the current drove her against a rock where she hid among the bushes. But the missionary landed his Indian servants, the miserable woman was brought back, cruelly scourged, her hands bound fast behind her back, and thus she was dragged to the Christian mission of Gavita. It was the rainy season, and the nights were dark; on account of the impassability of the forests, the rivers are the only means of communication between village and village. Maternal love urged the chained woman to attempt the apparently impossible, for she felt but the one desire to liberate her children, and take them back to the others at home.

She was unwatched—as her arms were bleeding, the Indian servants of the Christian missionary had from pity, secretly loosened her thongs; with her teeth she separated them entirely. The next morning she had disappeared, and was seen four days after, near San Fernando, where her children were imprisoned in the mission. She had passed through the woods at a season when the sky is always covered with clouds, and the rivers overflowing; she had often been obliged to swim, often to make her way, bleeding, through the prickly bushes, and had lived only on large black ants. The Christian missionary rewarded her unheard of courage by imprisoning her in a mission on the Orinocco, where, despairing of seeing her beloved children again, she refused all food, and died.

Humboldt could not look without emotion on the rock, on the western shores of the Atabo, where the woman had endeavoured to escape; it is called the "rock of the mother" to this day. Humboldt exclaims: "if man scarcely leaves a trace of his existence in these deserts, the name of this rock, an imperishable monument of nature, will remain as a memorial of the moral perversity of our age, of the contrast between the virtue of the savage, and barbarism of civilized men. This is to the memory of a victim of the bigotry and savageness of miserable wretches, who called themselves servants of a religion whose first command is love of one's neighbour."

ASCENT OF THE CHIMBORAZO.

When Humboldt and Bonpland had arrived at Quito on the Magdalen stream on the 9th January, 1802, they devoted themselves for nearly nine months to geological and botanical investigations of this district. They wished also very much to ascend Chimborazo, considered to be the highest mountain on the earth, and for this purpose excursions were made to the snow covered tops of the Andes, especially to the points of Antisano, Cotopaxi, Tumguragua, Pichincha, and Chimborazo.

Two unsuccessful attempts to reach the crater of the volcano Pichincha had been already made, when they at last twice succeeded in making experiments and observations here. Humboldt did not find the crater cooled and filled with snow as a former traveller had done, but inflamed and preparing for a volcanic eruption. When Humboldt subsequently brought this information to Quito, which is only four or five thousand toises distant from the crater, it excited universal lamentation in the town, from fear that an approaching eruption of the Pichincha would be dangerous for the inhabitants of Quito.

But this visit to the volcano had nearly cost Hum-

boldt his life. When he arrived at the top, he proceeded onwards over the snow to cross a deep chasm, not imagining that the bridge over this chasm consisted only of a fragile layer of frozen snow. At the first step he sank, and would have been lost had not adequate assistance been at hand. Higher still than Pichincha, in the cordilleras of the Andes, lies another crater called Cotopaxi, which interested Humboldt all the more because it is the highest active volcano of the modern world. It is 17,892 feet (2952 toises) high, therefore, if the Brenner of Tyrol were placed on the top of the peak of Teneriffe, the two together would only be the absolute height of the Cotopaxi. The whole district fears this volcano as a most dangerous enemy, for its eruptions have always been extremely desolating in their effects. In the year 1738 the flames rose 462 toises in circumference above the brim of the crater; in 1740 its roaring was heard at a distance of 200 miles, at Honda, on the Magdalen stream; in the year 1768 it ejected so many ashes that the air was darkened, and the nocturnal darkness lasted till three o'clock in the afternoon, so that the inhabitants of Hambata and Tacunga were obliged to go on the streets with lanterns; and in 1803, after Humboldt had been there, it spread great alarm by one of the phenomena preceding the eruption, namely, that all the snow suddenly melted, evidencing a dreadful heat of the crater.

In order to reach this dangerous volcano, Humboldt took the way south-east of the town of Quito, in the Andes. It was a journey of twelve (German) miles. The form of the mountain was majestic, colossal, and very regular in its cone. The tops, covered with a brilliant mantle of snow, shone in the setting sun in beautiful colours, and no irregularity of the soil, no rock or stone intercepts the radiance of the white surface. Humboldt only remarked some single dark pieces on the extreme verge of the crater, which, like those on the peak of Teneriffe, resembled a wall or rampart.

The weariest part of the ascent was the entourage of the mountain, which consists of rocks and chasms continuing up to the snow boundary. This boundary begins already at an elevation of 2460 toises, and is 533 toises broad to the crater. It was not possible for Humboldt to reach the brim of the crater. On the south-western side the regularity of the cone is broken by a mass of rock half buried in the snow, which the natives call the head of the Inca. It is said to have been originally the real point of the Cotopaxi, but to have been blasted and thrown down at its first eruption.

As he could go no further on this side, Humboldt went to the volcano of Antisano, to reach the utmost practicable height of the extreme point of the Chimborazo. He and his companions had already ascended to a height which before them no one had reached, when, on the 23rd June, 1802, he arrived on the Chimborazo, and succeeded in bringing the instruments so high. He was then 3036 toises above the level of the sea, and suffered the consequences of the great rarefication of the air. The thermometer stood still, as the mercury in it had frozen, and as mercury only freezes at 32 degrees Réaumur, or 40 degrees Celsius, the reader may form an idea of the cold to which Humboldt and his companions were exposed. The rarefied air made respiration very difficult; and as the circulation of the blood in the human body requires a pressure of air from without, to impart a certain degree of imperviousness to all the fibres and veins, the bold travellers soon felt the want of this pressure by the blood flowing from their eyes, lips, and gums.

But in sight of the extreme point of Chimborazo, only 224 toises higher, the difficulty of respiration and the flow of blood could not deter Humboldt from continuing his journey. Nature, however, drew a boundary to oppose the progress of the courageous man. A broad, insurpassable chasm gaped before him, and separated him physically from the top of the Chimborazo, towering proudly above him.

When they were already far away, the Cotopaxi sent a thundering adieu after them. We have already mentioned that Humboldt found this crater, which had been dead since 1768, and had since then not even ejected smoke or a visible vapour, quite hot, and had by this news excited great depression and terror in the town of Quito. He had already departed, and was in the port of Guayaquil, distant fifty-two miles in a straight line from the mountain, when he heard the roaring of the Cotopaxi, like a cannonading, night and day, and was even pursued by this fearful noise of the crater near which he had lately been, as far as the south sea, south-west of the island de la Puna. He afterwards heard that the subterranean fire in this mountain had been so violently developed in a single night, that the thick snow covering, 533 toises in breadth, had suddenly disappeared, and that at sunrise the usually snowy portion of this immense peak was covered with glazed lava, which towered threateningly over the terrified population of the district.

VEGETABLE LIFE.

The carpet which a fertile flora spreads over the naked surface of the earth is unequally woven; it is closer where the sun rises higher in the never-clouded sky, and looser towards the sluggish poles, where the returning frost nips the budding blossom or the ripening fruit. But the plants necessary for the food of man are found everywhere.

If a volcano divides the boiling tide at the bottom of the sea, and suddenly projects a lava rock, the peaceful lithophytes build their cellular dwellings upon it, and after thousands of years they raise it to the surface of the sea, die, and leave a flat coral reef. The organic forces are now immediately at hand to vivify the dead rock. Whether migratory birds, or winds, or waves of the sea suddenly bring the seeds, is difficult to ascertain, from the great distance of the coast.

But in the northern regions, as soon as the naked rock comes into contact with the air, a tissue of velvety fibres is formed upon it, like a coloured spot, darkening gradually, and affording the foundation for a new stratum of the organic tissue. Where high forest trees now stand, frail lichens once covered the earthless rock. The history of vegetable life, and its gradual distribution over the bare earth, has its epochs, like the history of the subsequent human race. But although the plenitude of life is everywhere developed, although organization is ceaselessly working to reunite the elements, released by death, into new forms, this plenitude of life and its renewal differs according to the difference of the zones.

Nature is suddenly torpified in the frigid zone, for fluidity is the condition of life. Animals and plants are here buried for months in their winter torpor (except mosses and other cryptogamia). On a large surface of the earth only such organic creations have developed themselves as are capable of withstanding a considerable absence of caloric, or a long interruption of the organic functions. But the nearer we approach the tropics, the more the variety and grace of form and colouring, the freshness and force of organic life increase. This may be doubted by those who have never left our quarter of the world, or have neglected the study of geography. If we descend from our thick oak forest over the Alps or Pyrenees to Italy or Spain, or cast a glance at the African coasts of the Mediterranean, we should easily form the erroneous opinion that absence of trees is a characteristic of hot climates. But then we forget that southern Europe bore a different aspect when the Pelasgian or Carthaginian colonies first settled there; we forget that the early civilization of the human race dislodges the forests, and that the revolutionary spirit of nations gradually robs the earth of those ornaments which gladden us in the north, and which, more than any history, proves the infancy of our civilization.

But besides this, in all countries bounded by the Mediterranean, a great portion of the earth's surface is bare rock. The picturesque character of Italian landscapes consists principally in the lovely contrast between the infertile bare rock and the luxurious vegetation which rises island-like upon it. But where this rock is less split, and retains the water on its surface, which is then covered with earth, as the lovely shores of the lake of Albano, there Italy has its oak forests as shady and green as the denizen of the north could desire. But if a district has once lost its vegetable covering by inundation or volcanic revolutions, if the sand lies undisturbed and without springs, if the hot air rising perpendicularly hinders the fall of the clouds, then ages elapse before from the green shores a new organic life penetrates into this desolation. He, therefore, who can survey nature at a glance, and deduct the consequences of local conditions, sees how organic force and richness increase with the increase of the vivifying warmth from the poles to the equator, and how yet every zone has its peculiar beauties. The tropics have variety and size of the botanical formations, and the north has the sight of fields, and the periodic revival of nature at the first spring-breezes.

Although the character of a district depends on all its visible phenomena, although the form of mountains, the physiognomy of plants and animals, the blueness of the sky, the form of clouds and transparency of the atmosphere, complete the total impression, the vegetable covering always remains the chief feature in this impression. The animal organization wants mass, and the mutability of the individual often withdraws them entirely from the scene; but the vegetable world impresses by its immovable grandeur, its masses show its age, and in plants alone are age and ever-renewing youth coexisting. The finite life of the animal world, although it more affects our feelings of goodwill or aversion, always remains foreign to the physiognomy of a

district; this is produced solely by its vegetable development. The agricultural nations artificially increase the prevalence of social plants, but with it, in many parts of the temperate and northern zones, the monotony of nature; they also destroy wild growing plants and cultivate others, which always follow men on distant pilgrimages. The luxurious tropics, however, successfully withstand all these violent revolutions of creation.

TROPICAL SKETCH.

In the mountainous districts near the equator, the diversified character of nature has attained its climax. In the deeply indented Andes of New Granada and Quito, we can see all formations of plants, and all stars of the heavens, co-equally. One glance takes in heliconias, high-topped palms, and above these tropical creations, oak forests, mespilia, and umbellifera, as in our native land. One glance takes in the Southern Cross, the Magellan clouds, and the principal stars of the Bear, which revolve round the north pole. There the earth and the two hemispheres of heaven display the entire abundance of their various forms; there the climates, and the botanical zones induced by them, are ranged above each other; there the laws of heat become clearly intelligible to the attentive observer, for they are graven in indelible characters on the rocky walls of the Andes, on the precipices of the mountains; and if the tropical countries are more impressive by the richness and luxuriance of nature, they are also especially calculated to show the regulated order of space, as it is reflected on the earth by the uniform regularity of the meteoric processes of the atmosphere, and by the distinct classification of natural forms, with a perpendicular elevation of the soil.

In the hot plains, which do not rise high above the level of the South Sea, abundance of pisang plants, of

cycadaceous and palm-like formations flourish; then follow the tree ferns, shaded by the high valley walls, and then come the cinchonias, in luxurious strength, being constantly watered and refreshed by the cool cloud-mist; they give the long mis-appreciated, now so useful Peruvian bark. Where the high tree-formation ceases, there azalias, thibaudias, and myrtle-leaved andromedas grow in close groups. The Alpine rose of the Cordilleras, the resinous befaria, forms a purple belt above them. Then, in the region of storms, the higher bushes and large-leaved plants disappear entirely, and panicled monocotyledons uniformly cover the ground, forming an immense field, shining with its yellow light. Here the camel-goat, and the cattle introduced by Europeans, graze in solitude. Where the naked rocks of trachyte project from the grassy plain, there, in the absence of clayey soil, only plants of the lowest organization can grow, such as the host of lichens, which the rarefied atmosphere sparely nourishes, parmelias, lecideas, and the many-coloured perisperm of the Leprarias. Islands of newly fallen snow hide the last developments of vegetable life, to where the boundary of eternal snow is sharply defined. The subterranean forces endeavour, but generally in vain, to break through the white, probably hollow, bell-shaped summits. Wherever they have succeeded in coming in contact with the atmosphere by round kettle-shaped craters, or long, narrow chasms, they scarcely ever eject lava, but only oxygen, sulphurous vapour, or hot water vapour.

. "When I indulge in personal recollections of great natural scenery, I think of the ocean, when in the mildness of tropical nights the firmament pours its planetary mild starlight over the gently undulating surface; or of the wooded valleys of the Cordilleras, where high palm stems break through the dark roof of foliage, and stand as a gallery of pillars—a forest above a forest; or of the peak of Teneriffe, when horizontally floating clouds separate the top from the lower earth, and, suddenly torn by a rising current of

air, the eye from the edge of the crater rests on the vine-covered hills of Orotava, and the Hesperidean gardens of the coast. In these scenes lies the calm, creative life of nature, its quiet working; in them is shown the individual character of the scenery—a mingling of the outlines of clouds, sea, and coast, in the virgin form of islands; there is beauty of vegetable form and grouping. For the irregular, the terrible, even in nature, everything which exceeds our power of comprehension becomes a source of enjoyment in a romantic scenery. Imagination has full scope for its creations in that which cannot be perceived by the senses; its influence is different at every change in the temper of the observer. We erroneously believe we take from the outer world what we ourselves have put into it."

THE SEA.

. . . "Whoever is roused to intellectual independence, and builds his own world within himself, must be excited by the view of the free, open sea, the majestic picture of boundlessness. His eye is enchained by the distant horizon, where dimly, like a mist, water and land unite, where stars descend and reflect themselves in the waters. A shade of melancholy longing mingles with enjoyment of this eternal change, as it always does with human pleasures. . . . A peculiar partiality for the sea, a grateful recollection of the impressions which the mutable element made upon me between the tropics in calm nocturnal repose, or when excited by the struggle of nature determine me to speak of the individual enjoyment of the prospect, before mentioning the beneficial influence which contact with the ocean undoubtedly exercises over the development of the intelligence and the character of many nations; over the multiplication of the ties which unite the whole human family; over the possibility of attaining to a knowledge of the formation of earth; and over the progress of astronomy, and of all mathematical and physical sciences. Since Columbus

was sent to unchain the ocean, man has been able to move more freely in intellectual regions."

EARTHQUAKES.

. . . "The impression which the first earthquake, even if it is unaccompanied by subterranean noise, makes upon us, is an inexpressibly powerful and quite peculiar one. This impression is not, I believe, the consequence of our recurrence to pictures of desolation which are present to our imagination from tradition and history. What moves us so powerfully is, the disappointment of our inherent faith in the repose and immutability of the firm, solid earth. From our childhood we are accustomed to contrast the moveable element of water with the quiescence of the soil on which we stand. All the evidences of our senses have confirmed us in this faith. When now the soil suddenly quakes, a secret power of nature appears mysteriously, as an active force, moving the immovable. A moment destroys the illusions of a life. We are undeceived as to the repose of earth, and feel transported within the sphere of destroying, unknown powers. Every sound, the least agitation in the air, excites our attention. We scarcely trust the ground on which we stand. The strangeness of the occurrence produces the same anxious uneasiness in animals. Pigs and dogs especially are overpowered by it; the crocodiles of the Orinoco, generally as dumb as our little lizards, leave the agitated bed of the river, and rush howling into the forests. To man, an earthquake appears as something omnipresent, unbounded. We can escape from an active eruption, or from a lava-stream flowing towards our dwelling; but during an earthquake, wherever one flies seems the hearth of destruction. This condition of the mind is, however, not of long duration. If a series of faint earthquakes follow upon each other, the inhabitants no longer feel any trace of fear. On the coasts of Peru, where it

never rains, the inhabitants know neither hail nor the rolling thunder and flashing lightning of the atmosphere. The atmospheric thunder is there replaced by the subterranean sounds which accompany the earthquakes. Long custom, and the universal opinion that dangerous earthquakes occur only two or three times in a century, have had such an influence that slight agitations of the earth cause no more alarm in Lima than a hailstorm would in the temperate zones.

The subterranean sounds, if unaccompanied by any sensible earthquake, make a peculiarly deep impression, even on those who have for some time inhabited a volcanic soil. They wait anxiously for what is to succeed the subterranean thunder. The most curious and quite singular example of uninterrupted subterrestrial sounds, without any trace of earthquake, is afforded in the phenomenon which is known in the Mexican highlands, by the name of the roaring or subterranean thunder of Guanamato. This celebrated and rich mining town, lies far from any active volcano. The noise had been heard for more than a month since midnight, the 9th January, 1784. It seemed as if heavy thunder clouds were lying beneath the feet of the inhabitants, and in which, slowly rolling thunder alternated with short thunderclaps. It was confined to a small space a few miles distant; on a basaltic soil nothing was heard. Thus the chasms open and close deep in the bowels of the earth."

AURORA BOREALIS.

. "Deep in the horizon, in the region where it is crossed by the magnetic meridian, the clear blue sky is obscured. An apparently thick fogbank is formed, which gradually rises to a height of eight or ten degrees. The colour of this dark segment plays into brown or violet. Stars are visible in this region of the firmament, seemingly obscured by a

dense smoke. A broad, but brightly luminous arch of light, first white, then yellow, bounds the dark segment. But as this luminous arch rises subsequently to the smoky-grey portion of the horizon, it is not merely a contrast with the brighter portion. In the extreme north, very near the magnetic pole, the smoky portion of the sky is less dark, and sometimes does not appear at all.

"The unsteady and scintillating luminous arch, sometimes stands for hours in the horizon, before any rays or groups of sparks separate from it, and rise to the zenith. The more violent the discharges of the aurora borealis are, the more actively do the colours play from violet and bluish-white, through all the shades, to green and purple. Magnetic columns of fire rise from the luminous arch, sometimes alone, and mingled with black rays, like dense smoke; sometimes simultaneously from opposite points of the horizon, uniting in a scintillating sea of fire, whose splendour no description can portray, as its waves of light change and vary in form and colour every moment. This motion increases the brilliancy of the phenomenon. The rays at last unite in that point of the firmament, answering to the direction of the magnetic needle, and form what is called the crown of the aurora borealis. But this crown is rarely perfect, and always immediately precedes the termination of the northern light. The rays then grow shorter, rarer, and more colourless, the crown and the arches of light fade, and soon after, the sky is only covered by irregularly grouped, broad, pale, almost ash-grey, immovable spots. They also vanish, before the trace of the dark smoke-like circle standing deep in the horizon is lost. At last nothing remains of the whole scene but a white thin cloud, feathered at the edge, or separated into small round divisions."